HUGO GERNSBACK, *Editor*

RADIO CRAFT

IN THIS ISSUE

Midget Television Preamp

Servicing Wind Generators

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MAY 1 1948

)0-TUBE ELECTRON BRAIN

SEE PAGE 28

MAY
1948

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ADIO-ELECTRONICS IN ALL ITS PHASES

RCA scientists—pioneers in radio-electronics—apply the "radio tube" to communications, science, industry, entertainment, and transportation.

This "magic lamp" makes Aladdin's look lazy

You will remember the fabulous lamp—and how it served its master, Aladdin. Serving you, today, is a real "magic lamp"... the electron tube.

You are familiar with these tubes in your radio, Victrola radio-phonograph or television set... but that is only a small part of the work they do. Using radio tubes, RCA Laboratories have helped to develop many new servants for man.

A partial list includes: all-electronic television, FM radio, portable radios, the electron microscope, radio-heat, radar, Shoran, Teleran, and countless special "tools" for science, communications and commerce.

The electron microscope, helping in the fight against disease, magnifies bacteria more than 100,000 diameters, radar sees through fog and darkness, all-electronic television shows events taking place at a distance, radio-heat "glues" wood or plastics, Shoran locates points on the earth's surface with unbelievable accuracy, Teleran adds to the safety of air travel.

Constant advances in radio-electronics are a major objective at RCA Laboratories. Fully developed, these progressive developments are part of the instruments bearing the name RCA, or RCA Victor.

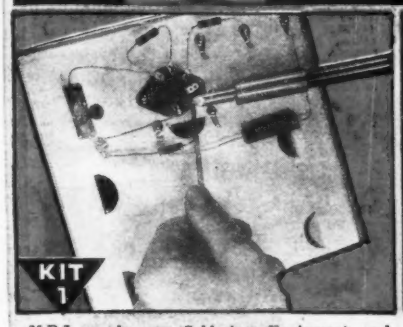
• • •

When in Radio City, New York, be sure to see the radio, television and electronic wonders on display at RCA Exhibition Hall, 36 West 49th Street. Admission is always free. Radio Corporation of America, RCA Building, Radio City, New York City 20, N. Y.

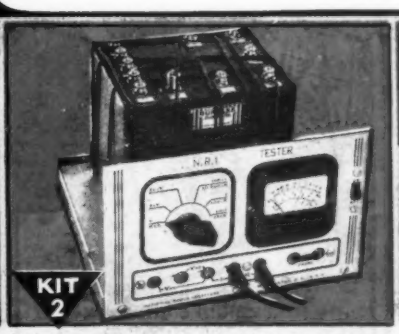
RCA **RADIO CORPORATION of AMERICA**

I BROKE INTO RADIO
BY PRACTICING IN SPARE TIME
WITH THE BIG KITS FROM N.R.I.

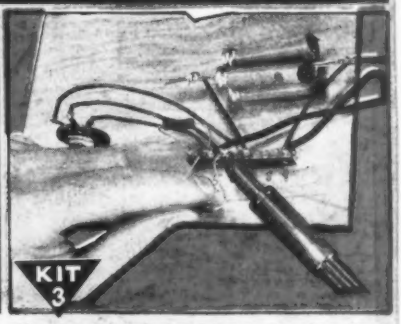
HOBERT HEAD



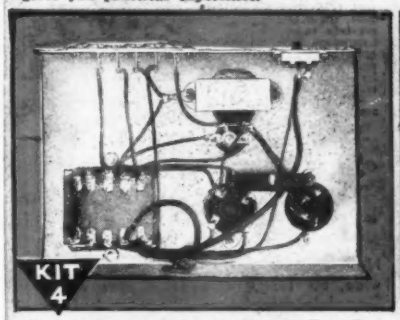
N.R.I. sends you Soldering Equipment and Radio parts; shows you how to do Radio soldering, how to mount and connect Radio parts; gives you practical experience.



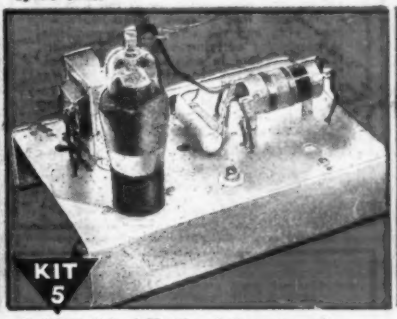
Early in the course you build this Tester with parts N.R.I. sends. It soon helps you fix neighborhood Radios and earn EXTRA money in spare time.



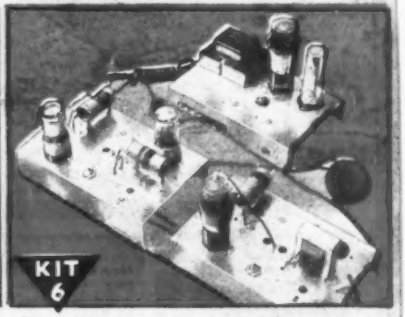
You get parts to build Radio Circuits: then test them; see how they work, learn how to build special circuits, how to locate and repair circuit defects.



You get parts to build this Vacuum Tube Power Pack; make changes which give you experience with parts of many kinds; learn to correct power pack troubles.



Building this A.M. Signal Generator gives you more valuable experience. It provides amplitude-modulated signals for many tests and experiments.



You build this Superheterodyne Receiver circuit. You conduct FM (Frequency Modulation) experiments. You get more experience to help you win success in Radio.

LEARN RADIO by Practicing in Spare Time

Do you want a good-pay job in Radio—or your own money-making Radio Shop? Mail Coupon for a FREE Sample Lesson and my FREE 64-page book, "How to Be a Success in RADIO—Television, Electronics." See how N.R.I. gives you practical Radio experience at home—building, testing, repairing Radios with BIG KITS OF PARTS I send!

Many Beginners Soon Make Good Extra Money in Spare Time While Learning

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Future for Trained Men Is Bright in Radio, Television, Electronics

It's probably easier to get started in Radio now than ever before because the Radio Repair Business is booming. Trained Radio Technicians also find profitable opportunities in Police, Aviation, Marine Radio, Broadcasting, Radio Manufacturing, Public Address work. Think of even greater opportunities as public demand for Television, FM and Electronic devices continues to grow! Send for free books now!

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Mail Coupon for Sample Lesson and my 64-page book. Read the details about my Course. Read letters from men I trained, telling what they are doing, earning. See how quickly, easily you can get started. No obligation! Just MAIL COUPON NOW in an envelope or paste it on a penny postal. **J. E. SMITH, President, Dept. 8EX, National Radio Institute, Pioneer Home Study Radio School, Washington 9, D.C.**

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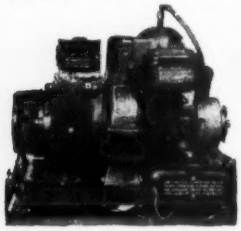
RADIO-CRAFT, May, 1948, Volume XIX, No. 8. Published monthly by Radcraft Publications, Inc., 29 Worthington Street, Springfield 3, Mass. Entered as second class matter at Post Office, Springfield, Mass., under the Act of March 3, 1879.

War Surplus Bargains Sold As Used Unless Otherwise Specified!

(HRU) DC POWER SUPPLY

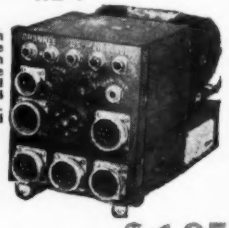


24-28 V. at 70 amp. 2000 watts gasoline engine generator with electric starter. Power supply which can be used to operate 24-28 V. equipment, start airplane engines, charge batteries, as a welding machine, lighting system, or for amateur radio station. 21½", 17½" x 24⅝". Wgt., 115 lbs.

$72.50

Includes 20 ft. plug-in cable.

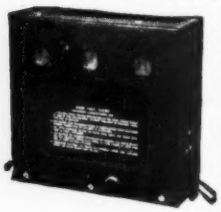
INTERPHONE AMPLIFIER RL-7



Convert to high fidelity phone Amp. or speech Amp. Complete with tubes and dynamotor, for 24 V. DC operation. Used but in good condition.

SPECIAL PRICE $1.95

NEW WILLARD RECHARGEABLE STORAGE BATTERY



New 6 Volt battery in spillproof clear plastic case, housed in metal case for easy mounting. Applicable for a wide range of uses where battery power is needed. Shipped dry. Uses standard battery electrolyte available everywhere.

Price, each	$4.00
In lots of ten, each	$3.35
Without metal case, each	$3.00
In lots of ten, each	$2.85

OXYGEN TANKS

These oxygen tanks, removed from surplus aircraft, have a capacity of 500 lbs. pressure. Type D2, with complete regulator assembly. Size of tank 22"x5". Wt. 7 lbs.

$5.95

BRAND NEW SCR-625 MINE DETECTORS

ATTENTION, PROSPECTORS, MINERS, OIL COMPANIES, PLUMBERS, ETC.

Used by the Army to detect buried metallic mines. Its private use suggests the location of underground or underwater pipes, cables and ore-bearing rock, the location of metallic fragments in scrap materials, logs, etc., and the screening of personnel in plants for carrying of metallic objects. New, complete in original overseas packing container. Originally sold by War Assets for $166.00. The U. S. Forestry Service has recommended procedure for using the SCR-625 Mine Detector to find concealed metal in tree logs and other timber products.

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SCR-274N COMMAND SET

SCR-274N Transmitter and Receiver Assembly consists of 13 pieces which are: 4 dynamotors, 1 modulator, 1 remote control box, 2 transmitters, 3 receivers and one antenna relay unit and it has its own individual dynamotor. Each receiver employs 12 V. tubes. Each transmitter contains four 12 V. tubes and has a variable frequency and crystal calibrated master oscillator, driving two 1625 final amplifier tubes, 55-watt output, with built-in silver plated variable inductance antenna matching device. Oscillator and final stage have simultaneous tuning and the dial is directly calibrated in MC. Transmitters have slugged and capacity tuning, built-in high voltage and antenna switches. Modulator furnishes plate supply for transmitters and is equipped with a dynamotor for high voltage. Also supplied is one antenna relay with built-in antenna meter. Transmitters make ideal VFO driver unit. Easily converted to 110 V. 60 cycle operation. Wt., approximately 100 lbs.

PRICE..... $24.75

R-5/ARN-7 RECEIVER

Three bands 200 to 1750 KC. Complete with 17 tubes required. This set is ideal for conversion to home broadcast Receiver addition to ham shack, etc. Reported sold for many times the price when brand new. A Receiver that would be hard to pick up at this price. ONLY $19.95

Control Head available **$2.50 ea.**

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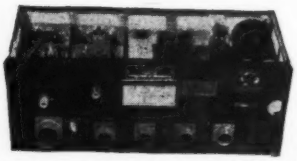


RADIO ALTIMETER APN 1

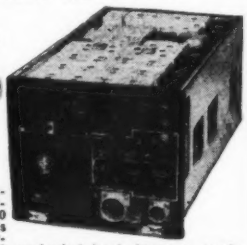
A complete 460 mc. radio receiver and transmitter which can be converted for ham or commercial use. Tubes used and included: 4-12SH7, 3-12SJ7, 2-6H6, 1-VR150, 2-955, 2-9004. Other components such as relays, 24 V dynamotor, transformers, pots, condensers, etc., make this a buy on which you can not go wrong. Complete as shown in aluminum case 18"x7"x7¼".

$8.95

NAVY CRV-46151 AIRCRAFT RADIO RECEIVER

INCLUDING CASE

$19.50



Four bands, including broadcast (195-9,050 KC). Circuit is six-tube superheterodyne with mechanical band change or remote operated electrical band change. Remote band change and tuning controls included, making this set readily adaptable to mobile ham use. Powered from self-contained 24 V. DC dynamotor.

The sets are complete with tubes, mounting rack and remote controls. No tables or plugs.

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New fire resistant, heavy canvas, 16' wide, 50' long, 12' apex, 4' side walls. Complete except poles.

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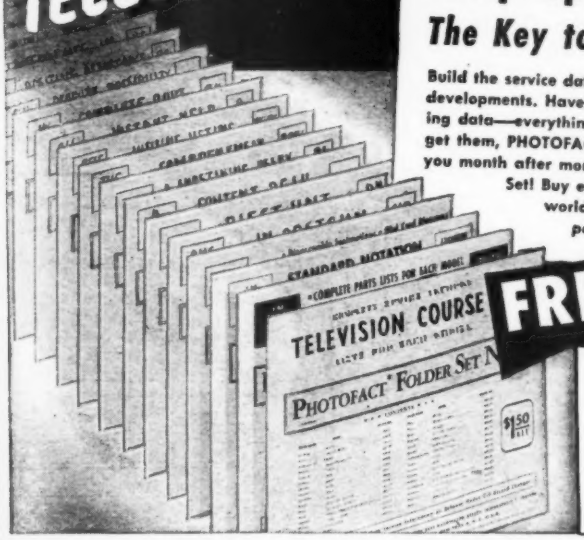

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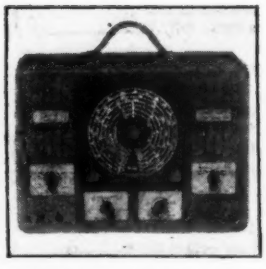

Model 3432—Illuminated dial Test Oscillator.
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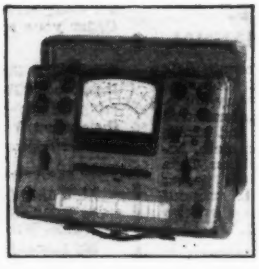

Model 3480—Combination Tube Tester Volt-Ohm-Mil-Ammeter.
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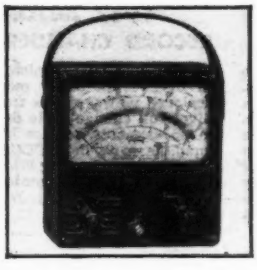

Model 625-NA — Wide Range Volt-Ohm-Mil-Ammeter.
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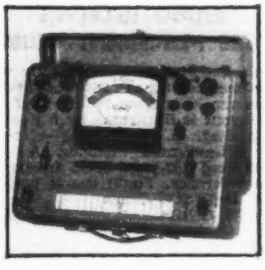

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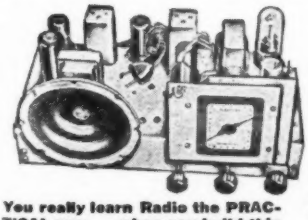
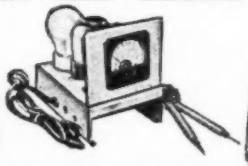


You really learn Radio the PRACTICAL way ... when you build this big, powerful 6-tube Superhet Radio from parts I send you.



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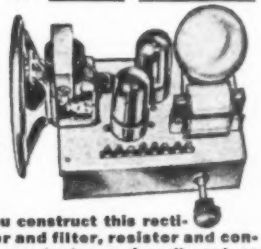

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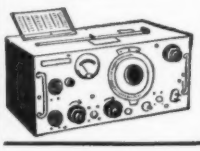

Measures frequency between 150 & 200 mc. by heterodyne method. Power of Xmtr can be directly measured. Measures DC voltages up to 500 Volts. Original operation on 110 V. 400 cy. but conversion kit makes it operable on 110 V. 60 cy. new, complete with tubes, crystal, cal. chart, antenna, meter & conversion kit and data for 110 V, 60 cy operation $29.95

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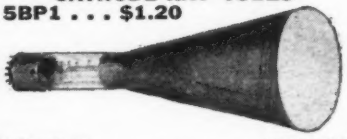

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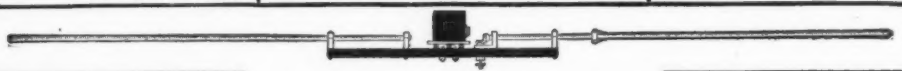

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Dynamic mike and headset combination. A high quality, efficient unit, used in B-19 tank Xmtrs. Mike and phones complete, new $2.75

R-15 headsets: 8000 ohms impedance, rubber cushions. Cones with 8' cord and plug PL 55. New $1.95. Used, in good condition ..... $ .60

HS 30 headset. Insert type headset cuts out background noise, and low impedance (500 ohms) assures efficiency and high fidelity. A MUST for every ham at this price ..... $ .85

Xfmr to match 8000 ohms output ..... $ .35

ANTENNA, AN/122-A. Used in 4-element sdcock arrays for high gain and directivity, each dipole element is 12' long, made of ¾" tubing. Excellent for that new 6 or 2-meter beam. Don't miss this great value. $5.65 each or 4 for $20.00

ANTENNA AN/104-A. The famous ax-handle antenna, used with the SCR 522. Ideal for mobile quarter wave, because of its streamline construction; or 2 units can be used to form a dipole for 2 meters or for TV and FM reception. Consists of copper sheath 21" long moulded about a wooden support, with 83-1R coax connector. $.75 ea., or 2 for $1.35.

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7220-24, Contactor, SPST, 24-28 vdc, contacts 400 amps $1.20
1077BF, Antenna changeover, DPDT, 28 vdc. $1.15

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SC 5853 A, SPST w/spdt section, 24 vdc, 1000 ohms $1.10
EE 89 Repeaters, for extending range of field telephone sets such as EE-8, etc. from 15 to 25 miles. New, with spare tube, less batteries $18.50

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All Primaries—117 V 60 cycles

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5110: 1100 v. @ 70 ma, tapped @ 550 v. (for use with H.W. rect.) $2.75

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5109: 27 volts @ 6.8 amp, 6.3 v. @ 2.5 amp $2.75
13163: 2.5 v. @ 1.75 amp, 5 v. @ 3 amp, 6.5 v. @ .6 amp, 6.5 v. @ 8 amp $5.35
Doughnut Pil. Xfmr. Two 5.1 v. windings @ 5 amp. each, 15,000 volt test. $7.50
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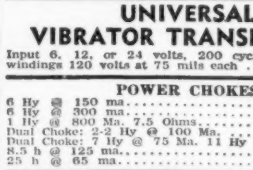
M.O. Coils	P.A. Coils	Antenna Loading Coils	Freq. Range
$1.00 each	$1.00 each	$.85 each	
#6029	#7247	#6033	3-4 Mc.
#6030	#9293	#6034	4-5.3 Mc.
#6032	#9295	#6035	7-9.1 Mc.

CONVERSION KIT, consisting of 1-M-O coil, 1-P.A. coil, 1-ANTKNNA COIL, in any one particular frequency range $2.00
ARC No. 6558 variable receiving capacitor, 62 mmf/section, 3 sections, .03" spacing, 8 rotors. Worm drive ratio 33:1 ..... $1.75
ARC No. 4990, variable xmtg. capacitor, 22.4—145 mmf, .05" spacing, 11 rotors. Each $1.00
ARC 5632 Var. Xmtg. capacitor, 29.3—117 mmf, .06" spacing, 16 rotors, worm drive: 96:1 ..... $1.00
Single rcvr. mtg. racks $1.00
Dual mtg. racks (rcvr.) $1.50
Single Shock mounts for rack ..... .50
DUAL CONTROL BOXES FOR RCVRS $1.00



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Dual Choke: 2-2 Hy @ 100 Ma. ..... .90
Dual Choke: 7 Hy @ 75 Ma. 11 Hy @ 60 Ma. $1.50
8.5 h @ 125 ma. $1.50
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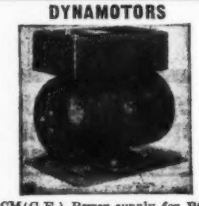

PE 73 CM(G.E.) Power supply for BC 375 Input: 28 VDC Output: 1000 VDC @ 350 Ma. New $4.95
BD 77KM Power supply for BC 191 with spare fuse links, etc. Input 14 v.d.c. Output 1000 v. @ 350 ma. New $9.95
Used, excellent condition $5.95
MFRS: Write for quantity prices and discounts on above items.
PE 101-C Input 13/26 VDC @ 12.6/6.3 A. Output: 400 VDC @ 135 Ma., 800 VDC @ 20 Ma. 9 VAC @ 1.12 A, new $3.49
PE 86 N, Input: 28 VDC, Output: 250 VDC @ 60 ma. $1.95
PC 77, Input 12 VDC, Output 275 VDC @ 110 Ma. 500 VDC @ 50 Ma. $3.25
DAG 33A Input: 18 VDC @ 3.2 A. Output: 450 VDC @ 60 Ma. $2.45
DM 33: Input 28 VDC @ 7 a. Output: 540 VDC @ 250 Ma. Power supply for SCR 274 modulator $3.95
DM 23350: Input: 27VDC @ 1.75 A. Output: 285 VDC @ 75 Ma. $3.50
DM 21: Input: 14 VDC, Output 235 VDC @ 90 Ma. Power supply for BC 312 ..... $2.49
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(Magnetrons)

Tube	Freq. Range	Pk. Pwr. Out.	Price
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2J21-A (725-A)	9345-9405 mc	50 Kw	$25.00
2J22	3267-3333 mc	265 Kw	$15.00
2J26	2992-3019 mc	275 Kw	$15.00
2J27	2965-2992 mc	275 Kw	$15.00
2J31	2820-2860 mc	285 Kw	$15.00
2J32	2780-2820 mc	285 Kw	$15.00
2J38	PKG. 3249-3263 mc	5 Kw	$25.00
2J55	PKG. 9345-9405 mc	50 Kw	$25.00
5J31	24,000 mc	35 Kw	$17.50
W.E. 700-A	680-710 mc	100 Kw	$30.00
W.E. 720-BY	2800	1000 Kw	$25.00

MAGNETS for 2J21-A (725-A), 2J22, 2J26, 2J27, 2J31, 2J31, 2J32 and 3J31, each $8.00

Field Strength (Gauss)	Distance Between Pole Faces	Pole Face Diameter	Price
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1500	1½"	1⅝"	$6.00
1000	Adjustable		
(Electromagnet)	2¾" to 3"	2½"	$12.00
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4 mmf	±.5 mmf	115 mmf	±2%
8.5 mmf	±.5 mmf	120 mmf	±5%
11 mmf	±5%	240 mmf	±3%
15 mmf.	±2.5 mmf	250 mmf	
48 mmf	±2%	500 mmf	+ 15 — 30%
50 mmf	±20%	1000 mmf	±5%
60 mmf	±3%		

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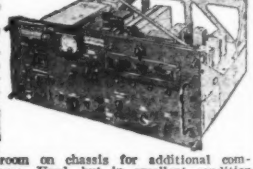
BC 1267 XMTR-RCVR.



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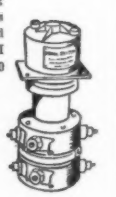

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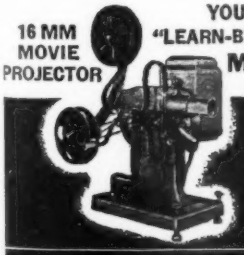

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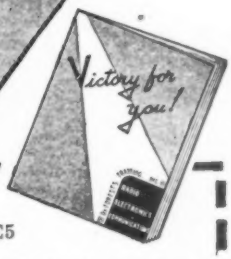

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RADIO CRAFT

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SHORT WAVE CRAFT* TELEVISION NEWS*
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International Business Machines' 12,000-tube computer which does the work of more than 1,000 mathematicians.

Chromatone by Alex Schomburg from Harris & Ewing photo.

ABC PAID CIRCULATION 6 MONTHS PERIOD TO DEC. 31, 1947—102,688. PRINTED FOR MAY ISSUE—153,000.

RADCRAFT PUBLICATIONS, INC. Hugo Gernsback, President; M. Harvey Gernsback, Vice President; G. Aliquo, Secretary

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RADCRAFT PUBLICATIONS INC. • PUBLICATION OFFICE 29 Worthington Street, Springfield 3, Mass. Address all correspondence to N. Y. office. EDITORIAL AND ADVERTISING OFFICES 25 West Broadway, New York 7, N. Y. Telephone REctor 2-9690. BRANCH ADVERTISING OFFICES: Chicago: 308 W. Washington Street, Chicago 6, Ill. Tel. Randolph 7363. Detroit: Frank Holstein, Manager, Room 402 Lexington Bldg., 2970 West Grand Blvd., Detroit 2, Mich. Telephone Madison 7026-7. Los Angeles: Ralph W. Harker, Manager, 606 South Hill St., Los Angeles 14, Calif. Tel. Tucker 1793. San Francisco: Ralph W. Harker, Manager, 582 Market St., San Francisco 4, Calif. Tel. Garfield 1-2481.

RADIO-CRAFT, May, 1948, Volume XIX, No. 8. Published monthly on 25th of month preceding date of issue. Allow one month for change of address. When ordering a change, please furnish an address stencil impression from a recent wrapper. All communications about subscriptions should be addressed to the Circulation Manager, Radio-Craft, 29 Worthington St., Springfield 3, Mass., or 25 West Broadway, New York 7, N. Y.

SUBSCRIPTION RATES: United States and possessions, Mexico, Central and South American countries, $3.50 a year; $6.00 for two years; $8.00 for three years. Canada, $4.00 a year; $7.00 for two years; $9.50 for three years. All other foreign countries, $4.25 a year, $7.50 for two years; $10.25 for three years.

FOREIGN AGENTS: Great Britain: Atlas Publishing and Distributing Co., Ltd., 18 Bride Lane, Fleet St., London E.C.4. Australia: McGill's Agency, 179 Elizabeth Street, Melbourne. France: Brentano's, 37 Avenue de l'Opera, Paris 2e. Holland: Technisch Bureau Van Baerle, Bemelmans & Co., Heemsteedsche, Dreef 124, Heemstede. Greece: International Book & News Agency, 17 Amerikis Street, Athens. So. Africa: Central News Agency, Ltd., Cor. Rissik & Commissioner Sts. Johannesburg; 112 Long Street, Capetown; 369 Smith Street, Durban, Natal. Universal Book Agency, 70 Harrison Street, Johannesburg. Middle East: Steimatzky Middle East Agency, Jaffa Road, Jerusalem. India: Susil Gupta (Distributors) Co., Amrita Bazar Patrika Lt., 14 Ananda Chatterjee Lane, Calcutta.

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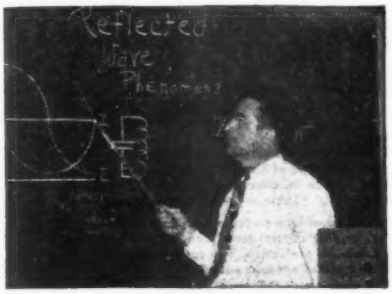

Mr. Albert C. W. Saunders' background includes association with the Marconi Company, teaching experience at Harvard and M.I.T.; founder Radio Technician's Guild; full member I.R.E.; Graduate, Portsmouth College, England. Mr. Saunders gave the first actual television demonstration in New England in 1935.

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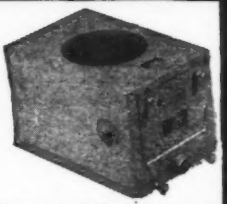
WILLARD 2 VOLT BATTERIES ONLY $1.25 each

Brand new. Compact spill proof. Built-in Hydrometer Group several together for higher voltages. Uses Standard Electrolyte Guaranteed Add 35c to cover postage and handling

MT53B ANTENNA

UNIT ONLY $1.95



This unit contains a single pole double-throw vacuum switch, which is capable of handling RF potentials as high as 20 KV. When used in DC circuits, the switch will handle over 1 ampere at 5 KV. (These are Manufacturers Specs.)

The case is ideal for a portable mobile receiver or a small transmitter, as your control panel can be mounted behind the hinged door for protection. The case also has a built-in high voltage insulated antenna post. Dimensions are 6½" x 7". Worth many times the price. Add 40c to cover postage and handling!.

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500' Telephone Wire now only $2.95

3 conductor braided insulated copper and steel telephone wire. It is of copper for conductivity and steel for strength. Worth at least 3c per foot, yet due to an exceptional buy we can now offer it at less than 1c per foot.

(Shipped express charges collect)

PHANTOM ANTENNA 85¢

A transmitting antenna, for use on approximately 450 MC. Complete with standard coax connector. A weatherproof unit. (Add 25c to cover handling and postage).

1300' Rubber Covered Wire

ONLY $18.00

New 4 conductor 16 gauge rubber covered cable. Color coded. Used by United States Government as Field Telephone Cable. 1300 feet on steel reel. F.O.B. Our warehouse Shipped motor freight or express shipping charges collect.

LOOP ANTENNA LP-21-A

ONLY $5.95

Used primarily on aircraft & Marine ADF Systems, Loop LP-21-A contains an electric motor and selsyn. These loops have been removed from salvage aircraft, but are guaranteed to be in excellent working condition.

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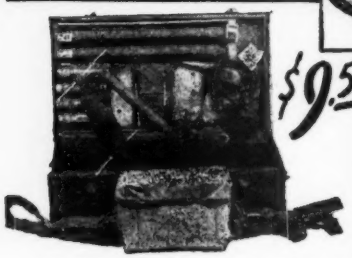
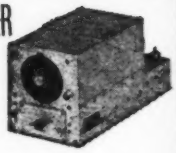


$9.50

Mine Detector type AN-PRS-1 Brand new complete (except batteries) in original case. Each unit contains an instruction Manual. Good for detecting objects under the earth's surface. Requires one 6 volt and three 4-5 volt batteries. (Shipped express charges collect)

COMMAND RECEIVER

BC454 BC455 $39.95



Your choice of either of these two famous Command Set Receivers. BC454 freq. range 3 to 6 MC or the BC455 6 to 9.1 MC. These sets are used, but in good condition. They are complete with tubes. Price—3.95 each.

(Shipped Express, charges collect)

Radio Compass

$17.25 each

RS/ARN7 or 433G, either of these Radio Compass Receivers complete with tubes. Ideal for conversion for home reception. Used but good. A real buy at only $17.25.

(Shipped express collect)

IMPORTANT! All merchandise subject to prior sale, minimum order $2.00, No C.O.D. orders accepted. Michigan residents must add 3% State sales tax.

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ESSE Specials!

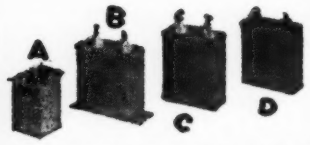
Do not fail to closely examine this list of bargains. We believe that every item listed below is a sensational value that soon can never be repeated. All equipment advertised herein is unconditionally guaranteed to the customer's satisfaction to this extent: Return any item advertised within five days after delivery for full refund except transportation charges (both ways).

(A) Filter condenser, G E Pyranol, oil filled 8 MFD @ 1000 volts DC working voltage, size about 1½" x 4" x 5" high, shipping weight about 3 lbs. Brown porcelain stand-off insulator terminals .....NEW **$2.00**

(B) Filter condenser, Sprague, oil filled, 8 MFD @ 1000 volts DC working voltage, size about 1" x 4" x 5" high, shipping weight about 2 lbs....NEW **$2.00**

(C) Filter condenser, 8MFD @ 700 volts DC working voltage. Oil filled, well insulated terminals. Size about 2" x 4¼" x 5" high, with mounting flanges, gray metal case, shipping weight about 4 lbs. .....NEW **$1.25**

(D) Filter condenser Cornel-Dubilier 1 MFD @ 4000 volts DC working voltage, oil filled. Size about 2¼" x 4" x 7" high over all. Shipping weight about 4 lbs. Heavy stand-off insulator type terminals. NEW **$3.75**



(A) Filter condenser, oil filled, 4 MFD @ 300 volts DC working voltage, size about 2" x 2" x 3½" high, shipping weight about 2 lbs. .....NEW **35c**

(B) Filter condenser, GE Pyranol, oil filled, 4 MFD @ 2000 volts DC working voltage, size 2¼" x 4" x 5" high, shipping weight about 4 lbs. .....NEW **$3.00**

(C) Filter condenser, Industrial Condenser Corp., oil filled, 1 MFD @ 3000 volts DC working voltage, size about 2¼" x 3½" x 5" high, well insulated terminals. Shipping weight about 3 lbs. NEW **$2.00**

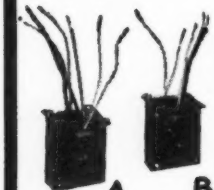
(D) Filter condenser, Industrial Condenser Corp., oil filled, 4 MFD @ 2000 volts DC working voltage, porcelain insulated terminals, size about 2¼" x 3½" x 5" high, shipping weight about 3 lbs. NEW **$2.50**

METERS — *Brand new and all checked for accuracy*

0-500 MA DC 3½" round NX35 Westinghouse	$ 3.00
0-5 Amps RF 3½" round NT35 Westinghouse Internal TC	4.50
0-3 Amps RF 2½" round NT33 Westinghouse, less TC	3.50
0-10 & 0-250 MA DC combination round NX33 Westinghouse	2.50
0-10 & 0-250 MA DC combination round DW41 G.E.	2.50
0-2 volts full scale 2000 ohms/volt Volume Level meter, Westinghouse, round 2½"	3.00
0-100 MA DC2½" round MD20001 McClintock	2.50
0-3 MA DC 3½" square 327A Triplett	4.50
0-500 Volts AC 3½" square 337A Triplett	6.00
0-2 Volts AC rectifier type 10,000 ohms/volt 327A Triplett 3½" square	15.00
0-50 MA AC 337A Triplett 3½" square	7.50
0-30 amps AC 3½" round case, 331JP Triplett	6.00

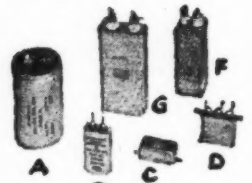
RELAYS — *All Brand New*

110v 60 cycle Plunger type for door lock	$ .50
RBM DPDT 110 v 60 cycle, make before break	.75
Relay, 6 MA 5000 Ohm DC resistance, SPDT	.85
Leach type 1127-FR 110 V 60 cycle DPST	1.50
Automatic Electric Co. DPDT 24 v. DC 6 Amp silver tungsten Contacts	.40
Automatic Electric Co. Delay relay, 20 ohm, silver tungsten contacts	.40
Starter relay, 28 volt operated, heavy duty construction	.50
Switch, pushbutton type DPST on/off type, to fit standard switchbox, 10 amps at 250 volts	.25
Switch, toggle type, bat handle, DPDT heavy duty contacts	.35
Leaf type switch, 4 poles, single throw, single hole mounting	.25



TRANSFORMERS

(A) Transformer, 110 volts 60 cycle input; output being two secondaries—each giving 14 volts @ 11 amperes, which can be used alone, in parallel, or in series for various voltage and current combinations. Size about 3½" x 3½" x 4" high. Ideal for operation of propeller pitch motors used for beam antenna rotation. Shipping weight 7 lbs. Manufactured for "Esse Radio Company." Brand NEW **$5.95**



(A) Condenser, electrolytic, 100 MFD. @ 300 volts, 2½" diameter, 4½" high, metal can, shipping weight 2 lbs. .....Brand NEW **$2.00**

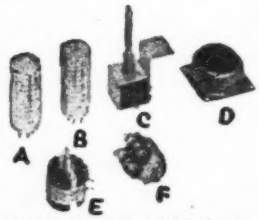
(B) Filter condenser, Tobe, oil filled, 1 MFD @ 600 volts DC working voltage, size about 1" x 1" x 2½" high .....NEW **20c**

(C) Condenser, bath tub type .1 MFD @ 1000 volts DC NEW **20c**

(D) Condenser, Tobe, oil filled, 3 x .1 MFD @ 600 volts DC at.. **25c**

(F) Filter condenser, Aerovox, oil filled, 2 MFD @ 600 DC working volts size about 1½" x 1½" x 5" high, shipping weight about 1 lb. .....NEW **35c**

(G) Condenser, Cornel-Dubilier, oil filled, 4 MFD @ 1000 volts DC working voltage, size about 1" x 2½" x 5" high, shipping weight 2 lbs. .....NEW **$1.75**



(A) Vibrator, Radiart VS-3, for 6 volt battery operation, used in vibrator supply PE104—which is used with BC654A transmitter-receiver. Type J-4 ....NEW $1.95

(B) Vibrator, Radiart VS-3, for 6 volt battery operation, used in vibrator supply PE104—which is used with BC654A transmitter-receiver. Type J6 (probably exactly the same as (A)) .....NEW $1.95

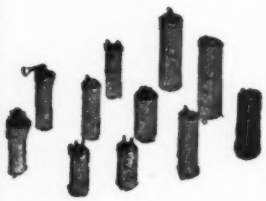
(C) Relay, 110 volt 60 cycle AC plunger type for door interlock .....NEW 85c

(D) Lord Shock Mount, heavy duty type, base size 3" square x 1½" high—⅜" diameter bolt may be used .....NEW 35c

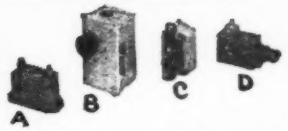
(E) Dual volume control wire-wound, each section 2500 ohms .....NEW 35c

(F) Toggle switch, bat handle. DPDT .....NEW 30c

CONDENSERS



Cornel-Dubilier—2MFD @ 1000 V DC, 1" Diameter 5" tall .....NEW $1.35
Cornel-Dubilier—4 MFD 600 V DC 1" diameter 5" tall .....NEW $1.00
Electrolytic 30 MFD @ 450 V DC Mallory F P aluminum can .....NEW 50c
Electrolytic 40 MFD @ 450 V DC Mallory F P aluminum can .....NEW 75c
Electrolytic, triple 20 MFD @ 25 V DC Mallory F P aluminum can .....NEW 35c
Electrolytic, 30 MFD @ 150 V DC, Mallory F P aluminum can .....NEW 35c
Paper, .05 MFD @ 400 V DC Solar .....NEW 10c
Paper, .5 @ 400 V DC Aerovox .....NEW 10c
Bath tub type .3 MFD @ 50 V DC .....NEW 10c
Bath Tub type .1 MFD @ 1000 V DC .....NEW 20c
Oil filled 3 x .1 MFD @ 600 V DC Tobe $1.95
1.75 MFD @ 50 V DC .....NEW 15c
.5 MFD @ 600 V DC .....NEW 15c
30 MFD—300 V AC G.E. Pyranol $3.00
Three gang trimmer condenser assembly, each adjustable 5 to 45 mmfds .....NEW 25c
Neutralizing, for 6 L 6 or 807 tube applications 10c
Variable tuning condenser, 7-17 mmfds 1½" shaft, ceramic insulation, single hole mounting 20c
Padder type variable, 100 mmfds the maximum, screw driver slot in shaft for adjustment .....NEW 20c
Padder type variable, 140 mmfds, maximum, screw driver slot in shaft for adjustment .....NEW 20c
Mica condenser kit, kit of many values and assorted capacities and voltages, about 100 condenser per kit .....NEW $1.98
Electrolytic 1000 MFD @ 15 V DC 1¼" diameter x 4½" high metal can .....NEW 45c
Electrolytic, mounts in octal tube socket 10, 5 and 15 MFD @ 100 working volts DC. Aluminum can .....NEW 50c
Electrolytic, 50 MFD @ 350 V DC Mallory F P aluminum can .....NEW 50c

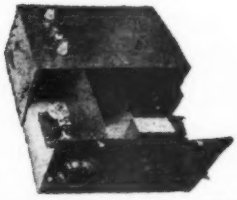


(A) Condenser, mica, .25MFD @ 250 volts .....NEW 15c

(B) Jack Box BC-631-B, size about 2" x 2" x 4", aluminum case, contains 10,000 ohm volume control, knob, Jones Barrier strip...Brand NEW 40c

(C) Switch, push-button type DPST on/off type, to fit standard switch box, 10 amperes @ 250 volts ....NEW 25c

(D) Micro-switch completely standard, metal grate well cast rated 15 amperes @ 115 volts normally open type, plunger has override feature. .....NEW 35c



RADIO MODULATOR

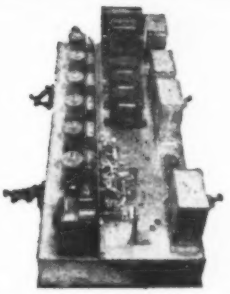
BC-424, made by Westinghouse, 110 volt 60 cycle AC operated. Size 9" x 14" x 9" high, weight about 30 lbs. packed. Has National Velvet Vernier Dial, Thordarson power transformer and chokes, tubes used and included are 6F6, 6J7, 6J7, 5W4 and 955. frequency about 190 megacycles. Comes with heavy steel case **$22.50**

BC-654-A—Receiver and Transmitter for frequencies 3800-5800 KC. Used but in good operating and mechanical condition. Worth many times the price for parts. Complete with all necessary tubes. Shipping weight 40 lbs. .....each $29.75

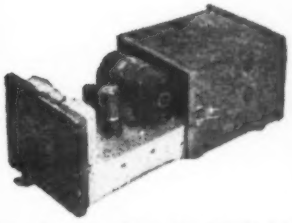
Microswitch, completely weather-proofed metal-clad or cased, rated 15 amps at 115 volts, normally open type, plunger has override feature	NEW	$ .35
Battery type BA-38, 103.5 volts, used in Handie-Talkie, Mine detectors, or for any purpose where low current drain is required. Size 1" x 1" x 11½" long. Outdated, but tests O.K.	NEW	3.00
Tube socket, RCA, for 866 or similar type tube bases	NEW	.35
Tube socket, wafer octal type, excellent mica insulation	NEW	.10
Tube socket for 813 type tube, Johnson type 237	NEW	.60
Tube socket, for Acorn type tubes, made by Millen Co.	NEW	.20
Tube socket, porcelain octal type, less mounting ring	NEW	.10
First IF transformer for BC348 type receiver, 915 kilocycles	NEW	1.00
Ohmite tap switch, model 111, 9 taps, non-shorting, will handle 10 amps at 115 volts	NEW	.35
Kit of potentiometers, twenty-five assorted sizes carbon and wire-wound	NEW	2.25
Resistor, voltmeter multiplier type, rated at 2 megohms 2 kilovolts insulation, 1 MA maximum current, about 1" diameter x 5½" long, mounts in clips	NEW	.75
Resistor, 100 watt type, 5 sections having 7500, 3000, 23, 23 and 750 ohms (total of 11,269 ohms) resistance. 1¼" diameter by 8½" long	NEW	.35
Cord CD-132, has PL-55 type plug and 9" cord, with spade type lug tips		35c
Sylvania type 1N26 crystal.....	NEW	35c
Resistor 20 watt, one-half ohm.....	NEW	10c
Fuse holder for type 3AG fuses.....	NEW	10c
Amphenol co-axial chassis connector, new, type 83-1R		40c
Amphenol co-axial junction connector, new type 83-1J		40c
Amphenol co-axial angle plug adapter, used, type 83-1AP		40c
Connector, bakelite insulation, male and female section, 6 pin polarized. Price		50c
Canvas bag, moisture & fungus proofed, with carrying strap, leather re-enforced corners, weight 3 lbs, size 9" x 14" x 12" high. Ideal for tool case, for sportsmen, etc.	NEW	$1.00

HAND SET T-S-10-G—Sound powered telephone. No batteries required for operation: connect to any two wires, wire fence and ground, etc., by convenient clips included. Price.....NEW $9.50 each

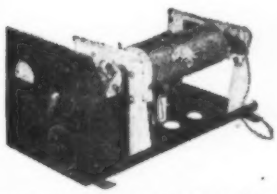
ARGON BULBS—2 watt ideal for transmitter tuning, night light, etc. Price 35c each. $3.00 per carton of ten.



BC-406-A Receiver—Brand new. Manufactured by Western Electric. 165 to 205 mc operation. IF frequency 19.5 mc. IF band width .7 mc. Easily converted for operation on other ultra-high frequencies. Operate from 110 V., 60 cycle, A.C. Worth many times this amount for tubes and parts. Tubes—one 5T4, two 68J7, four 6SK7, one 6N7, five 954's, one 955, one 6F7, one 6N7. Also contains small 110 V. operated motor. **$34.50**



Interphone Amplifier, size 7" x 9" x 6" high, weight about 12 lbs. packed. Contains 6SJ7 and 6V6 tubes, 24 volt dynamotor. Use for phono or intercom amplifier. **$3.75**



Antenna Tuning Unit BC-729-C, size about 9" x 9" x 19" overall, weight 24 lbs. packed. Contains 0-15 ampere RF ammeter 3½" square case, Tuning Inductance, having 60 turns heavy wire on 3½" dia. coil form, completely variable, also split stator coil with swinging link, vernier dial and revolution counter, will easily handle 500 watts of RF power. Will match up any length antenna to any common frequency for amateur transmitters. **$9.50**

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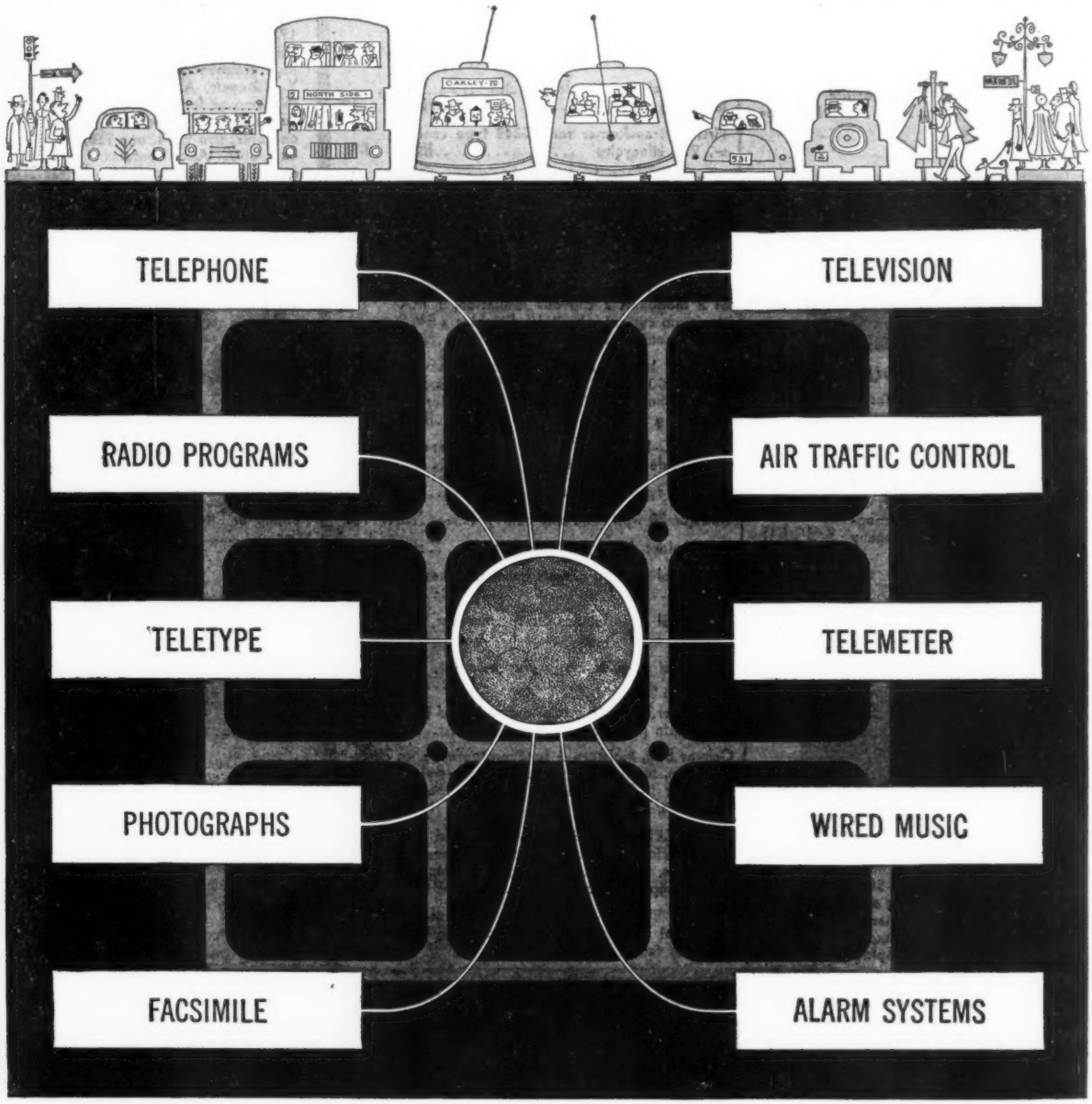
Traffic is heavy under the street, too

Surely the busiest thoroughfare in the world is a telephone cable. But it is more than "telephone"; for these thousand or more wires, carrying sound and pictures at lightning speed, are highways for many different services.

Each one of these presents its own problems to Bell Laboratories scientists and engineers: for the telephone differs from television, and television differs from a radio program. And yet they have an essential unity: they involve transmission of alternating currents, with frequencies from zero up to several million cycles. Each calls for new thinking, new ideas, new goals of accomplishment.

The diversity of the cable's many services speaks for the unity of Bell Laboratories' purpose. That is, to know the theory of communication so thoroughly, to practice the art so skilfully, that any transmission of sight or sound can reach its destination clearly, quickly, economically.



BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for continued improvements and economies in telephone service

APPLIQUÉD RADIO CIRCUITS

The next great radio advance is now in the making . . .

By HUGO GERNSBACK

THERE remains little doubt that the next few years will see a complete revolution in the building of our radio receivers, be they AM, FM or television.

It is certain that the wired radio receiver with its hundreds of wires and soldered connections will soon be completely outmoded.

The reason for this is elementary—from an economic standpoint wired and soldered radios are already dated, due to the tremendous labor costs. Then, too, receivers tend to become more complex as time goes on and the vast multiplicity of soldered connections no longer are workable. Servicing such sets is becoming more and more of a nightmare for that reason. Tracing circuits during trouble shooting is often a hopeless procedure and as the art progresses it becomes more hopeless both physically and economically.

At the present time top radio receiver manufacturers are racing toward the day when the wired component receiver will be replaced by something much simpler, which is cheap to assemble, and which will make servicing in the future a picnic—compared to our present receivers.

As reported in these pages repeatedly, the future receiver will either use a printed circuit in which the connecting wires are printed on a solid sheet of insulating material, or applied by some similar means. There are—and we mention only a few—the following:

Instead of printing the circuit it can be electroplated; it can be applied by the so-called silk screen process; or it can be done by spraying molten metal onto the surface.

Such new circuits also include the various resistors which are no longer solid blocks, but instead lines printed, sprayed, or applied to the surface by other means. An entire new art is springing up along these lines.

So far no "printed" radio sets have been produced for public consumption in the United States, but during the war there was great activity in this new art.

Dr. Cledo Brunetti, of the Bureau of Standards, outstanding exponent of printed circuits, produced many war radio sets where small size and guarantee of absolute performance were the prime considerations. These, however, were mostly along the miniature radio receiver lines. Standard receivers for home use, however, have so far not been produced.

In England one or two manufacturers have produced such radios, particularly those of the sprayed-circuit variety.*

Up to now there has not been an all-embracing term in the English language which would do justice to this new and very important art. Not all circuits are printed, nor are they plated, nor sprayed. Yet they all come under the same general classification.

We therefore advance the term *"appliqué"* (from the French)—rhymes with bouquet. The English dictionary defines the term as follows: "Appliqué—decorative detail superimposed on a solid ground, as in 'appliqué work.'"

Similar terms are "appliquéd" and "appliquéing." This term is now being used in various industries, such as textiles for instance.

The nearest all-English term would be application—"the act of applying or laying on," but obviously this term cannot be used. We can use the new term in various ways as: appliqué radio receiver; appliquéd radio circuits; appliquéing a circuit.

The great advantage of these new appliqué receivers is the fact that most handwork is done away with. *There are no soldered connections*—everything either being screwed on, riveted, or fastened by other mechanical means. This means that—as is now done in England—an entire radio set can be made by a robot; i.e., a machine that does all the work from beginning to finish, delivering the complete chassis at the other end of the production line. No human hand touches the chassis while being processed. This cuts manufacturing costs tremendously.

The enthusiastic proponents of the new art foresee the day when the average superheterodyne chassis, minus tubes and loudspeaker, can be sold for $1.00—certainly less than $2.00. The serviceman simply will take out the old chassis and discard it, replacing it with a new one. He will no longer hunt for hours to find a loose or intermittent connection—it will be far cheaper to install a new complete chassis with all its wiring, resistors, condensers, etc.

Some servicemen seem to think that this will ruin their business: Quite to the contrary, they will make *more* money because it will give them more time for installation and other radio work rather than wasting precious hours in hunting for open connections, blown condensers, burned-out resistors, and what not.

The future chassis will be light and small. It will weigh very little and will be completely foolproof. There will be few outside connections to be made to it, such as tubes, loudspeakers, etc.

Moreover, *the new appliqué radios will be equipped with miniature tubes,* for which they are ideally suited. To show how the wind blows, we quote the remarks recently made by L. W. **Teegarden,** vice-president of RCA Tube Department:

> "Today a large portion of RCA Tube Department production is assigned to miniature tubes. About 90% of all receiving tube developments is on miniatures."

Appliqué radios will bring down the price of ALL radio sets and particularly television receivers. At the present time only about 30,000 video sets can be manufactured a month. With appliquéd circuits, they can be manufactured by the hundred thousands per month, once the manufacturers have tooled up for the new art.

*See RADIO-CRAFT, September, 1947, issue.

RADIO-ELECTRONICS

COORDINATION of the efforts of radio technicians' associations is being undertaken under the leadership of the Federation of Radio Servicemen's Associations of Pennsylvania, the country's largest organization of radio technicians. Originating at a meeting held at Harrisburg in the early spring, the plan proposes to coordinate the objectives of member associations, to solicit the cooperation of all servicemen's associations with whom the Federation is in correspondence, and finally to invite participation in the organization's efforts to improve radio receiver servicing by servicemen and servicemen's associations wherever situated. The secretary of the Federation, Mr. John Rader of 704 Walnut St., Pittsburgh, Penna., was appointed secretary of the coordinating committee. Any interested individuals or organizations are requested to contact him.

The move toward coordination by the FRSAP was prompted by a review of the opinions the radio technicians representing more than 16 states at the Philadelphia convention last January.

MICROWAVE GENERATION with conventional tubes was demonstrated by DeMornay Budd Inc. at the recent Institute of Radio Engineers Convention. Development is expected to expand vastly the use of microwave equipment, which has been hampered by the necessity of designing it around the scarce and expensive Klystrons and magnetrons.

Previously, ordinary tubes, available for other purposes, have been considered unsuitable for microwave generation because of excessive transit time and grid conductance. This development overcomes these two problems by making the transit time between cathode and plate correspond to some multiple of 360 degrees phase shift. An alternate development achieves similar results by making the transit time correspond to any odd number of half periods of oscillation.

The potentialities for this development are considered to be an "open sesame" to the very roomy microwave region for amateur, citizens and mobile bands, relay and communication and navigation functions.

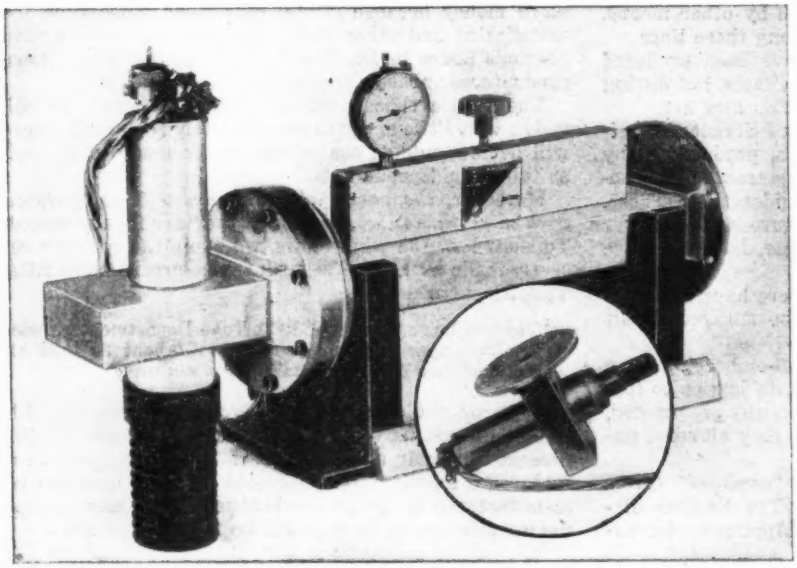
METALLIC TECHNETIUM, chemical element number 43, has been isolated by Dr. Sherman Fried of the chemistry division of the Argonne National Laboratory, it was announced last month.

One of the last four of the 96 elements to be named, technetium is revealed to be a silvery substance similar to the other rare metals, rhenium, osmium and ruthenium, which are located near it in the periodic table of elements.

Two tiny quantities of the metal were prepared from compounds manufactured in the atomic furnaces at Oak Ridge and made available by Dr. G. W. Parker of the Clinton Laboratories. Dr. Fried reported the isolation of the new metal in a report to the Journal of the American Chemical Society.

PUBLIC REACTION indicates that radio is doing a good job, according to a survey made by the University of Chicago's National Opinion Research Center. The report released last month reveals that 70% of the people interviewed approved of the job being done by radio in their communities. Only 59% were as satisfied with their schools, 63% approved of their newspapers, and 42% were as pleased with their local governments.

A further study of the figures showed that 67% of the people were against government control of radio news, 76% opposed regulation of radio advertising, and 65% were opposed to government control of the programming of controversial issues.



Equipment for generating power on microwaves with tubes now used at broadcast frequencies.

TELEVISION COMPETITION is cutting into the movies and regular radio programs, Ed James stated in the *American Magazine* last month.

A survey of television set owners in New York by CBS disclosed that nearly half had attended movies less frequently since obtaining the set, and more than half reported there was no radio program they preferred to television. "Television," said one set owner, "is more entertaining than radio and more convenient than movies."

SIGNAL CORPS SCIENTISTS are preparing to explore the surface of the moon with radar in an attempt to map its mountains, valleys, and craters. They will use electronic improvements developed since January, 1946, when the Signal Corps first made contact with the moon from the Evans Signal Laboratory, Belmar, N. J.

The scientists said that the difficult part of the first experiment was in building a receiver sensitive enough to pick up the radar echo. Since then they have greatly increased the sensitivity of the receiver which will be used in the new experiments at Evans laboratory.

PRIVATE OPERATION of radio broadcasting in Canada is receiving strong public support, it was reported at the fifth annual meeting of the Canadian Association of Broadcasters last month.

A Dominion-wide poll completed last December showed that 60% of Canadians polled favored private operation of radio against 22% in favor of a government-operated system. Canada has at present both a government broadcasting company and privately-owned stations.

RADIO FURNISHED TIME to people in California during the power shortage last March. The lack of power forced the Pacific Gas and Electric Company to reduce its frequency, causing all electric clocks to run six or more minutes slow per day. As soon as the situation became known, the principal radio stations began giving time signals on each station break, enabling listeners to keep their clocks adjusted.

ACCURATE RADAR SPOTTING of planes is prevented by this wartime development in which the plane itself in effect, becomes a non-reflector of radar signals. U. S. patent No. 2,436,578, issued last month to Arthur Korn of Hoboken and Joseph Hess and Simon L. Ruskin of New York, covers this invention.

The plane is coated with a substance that is a poor or "scattery" reflector of radar waves. Three such substances are cuprous oxide and the elements selenium and tellerium. Various methods of applying the coatings, all involving rolling or pressure at fairly high temperatures have been devised.

MONTHLY REVIEW

ATOMIC ENERGY will be used to power radio and television receivers in the future, David Sarnoff, President of the Radio Corporation of America predicted at Boston University Founders' Day ceremonies.

"A miniature power supply in capsule form may make possible radio receivers no larger than a wrist watch, and television sets that may be carried in the pocket like a camera," declared General Sarnoff. "When that day comes people may carry pocket-size radiophones that will enable them to communicate with home or office, no matter where they are."

These fascinating possibilities are not "just around the corner" General Sarnoff pointed out, but we shall see these promises fulfilled if the world is at peace and science is unfettered. Beyond today's horizon, he said, automobiles, tractors, airplanes, locomotives and ships may be powered also by small capsules of nuclear energy.

More optimistic on the subject of atomic energy is Dr. Edward U. Condon, who at the recent meeting of the Institute of Electrical Engineers in New York City predicted atomic power plants "within a year or two" and ships running on electric energy "within a decade." Atomic power plants are now under way at Oak Ridge, Tennessee, Chicago, Illinois, and Schenectady, New York, Dr. Condon told the assembled engineers, and it should be possible to realize experimental production of power within the next year or two. However, he believed that atomic power plants are likely to be too heavy for cars, planes or even railroad locomotives, though it is reasonable to believe that within a decade ships may derive their power from atomic piles.

A MICROWAVE RADIO relay system instead of the usual telephone lines is planned for the Rural Radio Network whose headquarters is in Ithaca, N. Y. The network expects to go on the air with three of its six FM stations early in May.

The new FM network, to be cooperatively supported by farmer organizations, will concentrate on the farm audiences in the agricultural areas of upstate New York.

THREE-YEAR LICENSES for FM stations will be issued beginning May 1, the FCC announced last month. This announcement complies with requests made by the Frequency Modulation Association. The Commission pointed out that it "recognized the rapid development of FM as meriting the statutory maximum license period."

First renewals will be for one, two, and three years to work into a staggered schedule of renewals by frequencies. Thereafter, all renewals will to be for the three-year period, according to the FCC.

THE INSTITUTE of Radio Engineers held its 1948 convention March 22-25 at the Hotel Commodore and the Grand Central Palace, New York City. The meeting was the largest on record, with an attendance of 15,000, as compared to the 8,000 engineers who appeared at last year's convention.

Dr. B. E. Shackleford, 1948 IRE president.

It was necessary to subdivide the subjects discussed and hold meetings simultaneously in five auditoriums to accommodate the more than 130 papers read. A symposium on nuclear science which consisted of five talks and occupied a full morning session indicated the Institute's interest in this very important new branch of science.

Dr. R. L. Smith-Rose, IRE'S vice-president.

The exhibits of new radio equipment also reached record figures, with 188 manufacturers displaying their equipment at the Grand Central Palace.

A special luncheon March 23 honored the new President, Dr. B. E. Shackleford, who with Dr. R. L. Smith-Rose as his vice-president, will lead the Institute in 1948.

THE RADIO PARTS SHOW will be held again at Chicago May 11, 12, 13, and 14. At this show, which is sponsored by the Association of Electronic Parts and Equipment Manufacturers, the National Electronics Distributors Association, the RMA, and the Sales Managers Club, all the leading manufacturers of radio and electronic components will exhibit their new products for the coming season.

It is believed that this year will see the industry's largest parts exhibition, and dealers, distributors and manufacturers expect to see a number of new developments, inventions and features which have been kept "under wraps" for release at the show.

TAPE RECORDINGS instead of discs will be used beginning April 25 for rebroadcasting of network programs by affiliates of the American Broadcasting Company during daylight saving time. This method will permit playbacks as needed with improved quality at lower costs.

Only regularly scheduled programs will be rebroadcast; outstanding special events will be aired live and when they occur.

"SNOWSTORM," a type of television interference that produces streaking on the television screen and is commonly produced by ignition interference has been found to be caused by the sun, it was reported last month.

Engineers of the British Broadcasting Corporation suspected the sun while they were tracing the cause of a brief but particularly violent snowstorm. A check with records of solar noises confirmed their suspicions.

TELEVISION RECEIVER production in February reached a new high level, the Radio Manufacturers' Association disclosed last month.

The manufacture of 35,889 sets in February brought the total number produced since the war to 250,937. The February television set output, 5,888 more than the January production, represented a 141% increase over the average 1947 monthly output.

TELEVISION WEATHER broadcasts are now being made on a daily basis. The ten-minute program, beginning at 6:05 pm, is carried over the Dumont stations in New York City and Washington, D. C.

EUROPEAN LISTENERS total between 150,000,000 and 175,000,000, according to a last month's State Department estimate. Over 100,000 of these are believed to have shortwave listening facilities.

THE MOTION PICTURE industry is planning to enter the television field actively, Frank Mullen, executive vice-president of the National Broadcasting Company, revealed at a press conference last month.

ELECTRET CONSTRUCTION

The author describes in detail the material, method and equipment for making electrets.

By VICTOR H. LAUGHTER

AN electret is a comparatively unknown scientific novelty which is the electrical counterpart of a permanent magnet. It consists of a slab of wax material that has been subjected to a strong electrostatic field while in the molten state. When the material is allowed to cool under electrical stress, a positive charge appears on one side and a negative charge on the other. These charges are retained for several years with little decrease in strength.

In 1925 Eguchi described a very interesting kind of electret made of equal parts carnauba wax and resin. These were melted and a high direct voltage applied while they were in the liquid state, the voltage remaining on until the mixture solidified. One theory of what occurs is that an orientation of the molecules takes place under voltage stress, this alignment being locked in by the cooling of the wax. The electret thus made shows a final positive charge on one side and a negative charge on the other. An electrostatic charge similar to the magnetic field of a permanent magnet, surrounds the electret. The writer has electrets three years old, apparently as active as when first made.

A unique feature is the action of the positive charge. When first removed from the cooker, the electret usually shows a positive charge on the side that was next to the negative polarizing plate and a minus charge next to the plus plate. This relationship is expected and is according to the law "unlike poles attract and like poles repel." Later a *reversal* of poles occurs; the positive side becoming negative, and the negative side positive. Once made, this reversal is permanent. The result is that the polarity on the electret is the same as that of the charging voltage. The positive charge thus formed holds. This is contrary to usual action. Normally a positively charged surface attracts free negative electrons, building up a negative space charge and thus shielding the positive effect. A crystal shows the negative shield. Just why the electret acts as it does is not known.

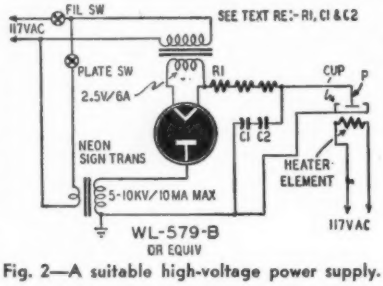


Fig. 2—A suitable high-voltage power supply.

The electret offers a wide field for the experimenter. Possible applications include a condenser mike with no polarizing voltage and no danger of breakdown, phono pickup, plate-repulsion-type oscillator, an interior element of vacuum tube in which the electret provides the necessary electrostatic voltage. Gemant has used electrets as plates of an electrometer, also as a microphone.

Equipment

The equipment shown in Figs. 1 and 2 was used by the writer in making electrets. High voltage is supplied by a neon-sign-type transformer delivering 5,000 to 10,000 volts at not more than 10 ma. The rectifier tube is a WL-579-B. Equivalents such as the 72, 73, RK-705-A, and 8013 may be used. The filament transformer must have good high-voltage insulation between its windings and should handle the rectifier tube used.

The current through the mixture decreases as the mixture cools, and the supply voltage rises to its peak value causing breakdown between the plate P and the cup. The dropping resistor R1 is included to prevent this breakdown. It consists of a number of small resistors connected in series and has a total value of about 50 megohms. One or more resistors may be shorted to adjust the voltage. The filter condensers C1 and C2 have a total capacitance of about 500 μμf and may be either air or mica types. The amount of capacitance is not critical.

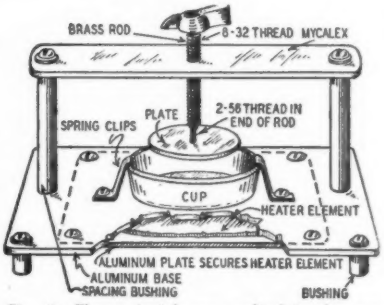


Fig. 3—The materials are melted in the cup.

Details of one type of cooker unit are shown in Fig. 3. Its base is made from ¼- or ½-inch sheet aluminum. An electric-iron heater element is mounted on the underside of the base and held in place with another sheet of aluminum.

Bushings support a mycalex strip which holds the plate. The strip is drilled and tapped at center for 8-32 threads. One end of a brass rod is threaded for an 8-32 nut. The other end is turned down and threaded for a 2-56 nut. The plate P is an aluminum disc about 1¼ inches in diameter and 1/16-inch thick, drilled and tapped at center for 2-56 screw. The cup is an aluminum drinking cup 2 inches in diameter and

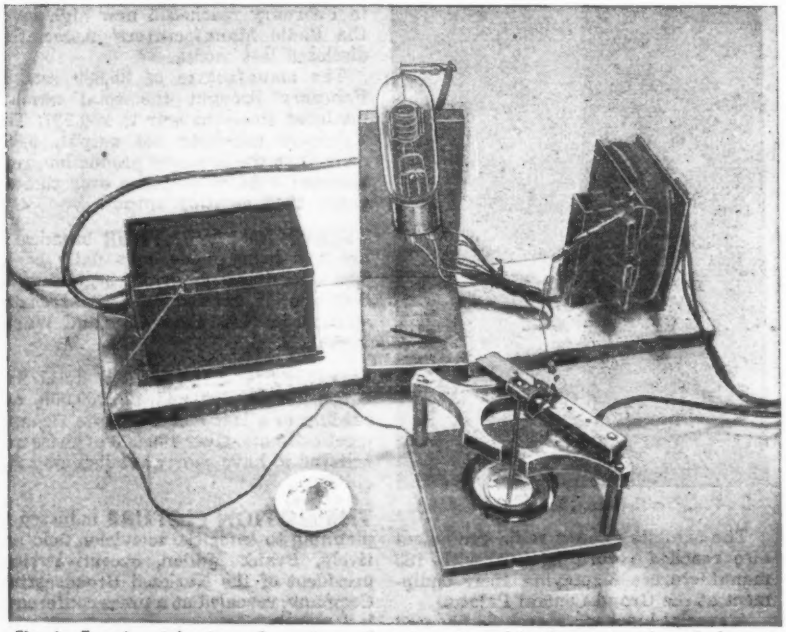


Fig. 1—Experimental set-up of one type of equipment used in the construction of electrets.

cut down to ½-inch height. Spring clips hold the cup firmly to the base. The cooker unit is simply a method for providing heat to a container holding the wax and a variable means for contacting the mixture, so you can change its construction any way you desire. The various electrical units should have separate switches so any desired operation can be selected. The writer has made several hundred electrets using sand pack, oil bath, gas heat and infrared, but prefers the type of heater shown here.

Materials for electret-making

The minimum material for making electrets consists of 1 pound of carnauba wax, 1 pound of resin, 1 pound of aluminum foil about .001-inch thick, a small can of silica gel or other dehydrant, and a quart can in which to keep completed electrets. Cut off a piece of foil and force down into and around the inside of the cup. Work smooth to remove wrinkles. Also wrap foil around the plate that is to contact the wax. The foil keeps the mixture from adhering to cup and plate, allowing easy removal. It can be stripped off later. Shave off about 2 teaspoonfuls of carnauba wax and resin. Place cup in position, run plate up out of way, and turn on only the heater.

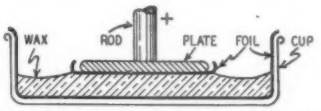


Fig. 4—Cross-section of melt ready to form.

Drop small quantities of the wax into the cup and stir the mixture with a rod as it melts. The depth of the wax should be about 3/16-inch for trial. Run the plate down until it contacts the melted wax. Connect the plate to the positive side of the high-voltage supply and the base to the negative side. The wax will wet the foil on the plate and allow backing up so that our final contact is about as shown in Fig. 4. Turn off the heater when the wax is thoroughly melted. Let the filament heat 15 to 30 seconds before applying plate voltage. The mixture should jump perceptibly when the high voltage goes on. If sparks break across from cup to plate, more resistance should be added to R1. Allow wax to cool to room temperature with voltage on. This should take 45 minutes to 1 hour. If for any reason you are dissatisfied with the product, remelt and remake. If the edges of cup are bent slightly, the cooled electret will break free and can be removed. Unscrew plate from rod and pry the electret off the plate with a knife blade. Strip off adhering foil and wrap in new foil. Place in the can—in which ½-inch of silica has been poured—until ready to test.

Testing electrets

The electrometer, a laboratory instrument, is the proper meter for testing electrets. Such meters are not generally available so other methods must be considered. The discharge test, as described here, can be made without cost and will

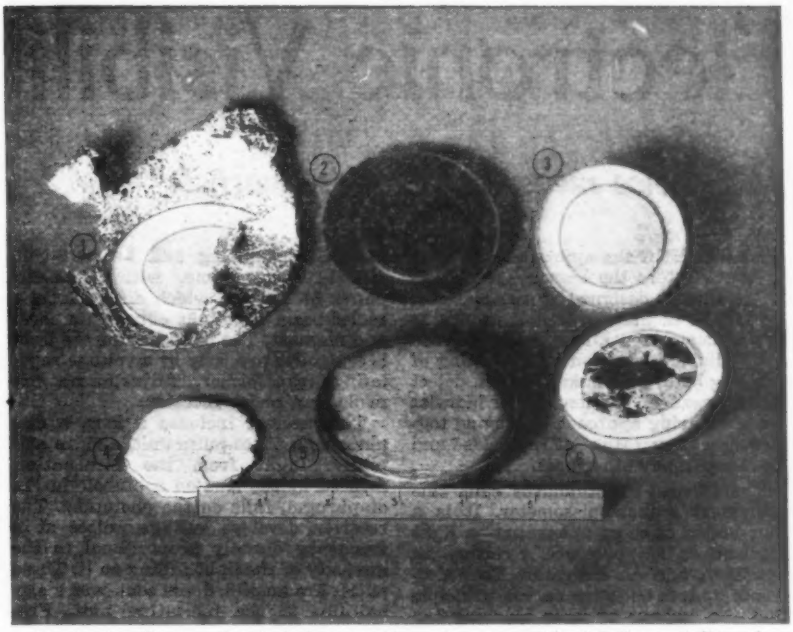


Fig. 6—A collection of typical electrets. Charge is preserved by foil "keeper" (No. 1).

reveal whether an electret is good or bad. To make this test, cut a disc of brass about .010-inch thick and slightly larger in diameter than the electret. See Fig. 5. Place the electret on a metal sheet (shown in Fig. 5 as COLLECTOR) resting on a block of insulating material. Hold the collector about 2 inches above the electret so that, when dropped, it will hit flat with the triangular part overhanging the electret coming in contact with the metal plate. What happens is that the collector, when dropped, travels through the electrostatic field, collects a charge which builds up, and is discharged when the triangle point contacts the metal plate.

HOW TO MAKE AN ELECTRET

A standard formula for electrets is Carnauba wax 45%, white resin 45% and white beeswax 10%.

Note that the collector has been cut with the triangular piece slightly longer than the thickness of the electret and bent down at an angle. The triangle section should be bent in or out for best spark action. *This test must be made in the dark.* Test both sides of the electret; one side will no doubt give a much heavier spark than the other. This is normal. Generally the heavier spark occurs on the negative side. The spark method is perfectly satisfactory as it indicates good or bad and, by the strength of spark, the comparative difference between electrets. A vacuum-tube voltmeter with an impedance of at least 1,000 megohms can be used and is of value for indicating positive and negative sides of an electret. This is a special type of instrument, however, and cannot be described in this article.

The wax mixture used by the writer is composed of equal parts of carnauba wax and Halowax. Halowax can be secured from the Halowax Products Division, Union Carbide and Carbon Corp. The addition of the Halowax gives an ivory-white finish, with good shrinking properties, allowing easy removal from cup. The electret should have a high melting point to be of more general use. It is advisable to experiment with various kinds of plastics and waxes that have a high melting range. Glass has been suggested as a medium and preliminary tests show some conductivity. The actual arrangement of the furnace, electrodes, and leads is a serious problem for the experimenter.

It may be that actual conductivity is not important as the electrical stress will no doubt give the proper orientation. So far tests indicate that the electret must have a fairly hard and brittle finish. Likewise some carnauba wax, even though in minute quantity, must be included in the mixture. Some component of carnauba wax forms under the electrical stress the permanent characteristic of an electret, but just what this element is is not known. Electrets

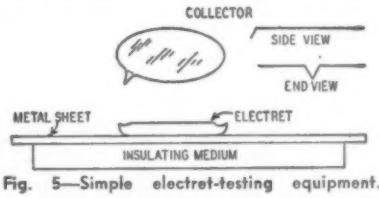


Fig. 5—Simple electret-testing equipment.

made without carnauba wax show only a temporary charge. It has been suggested that the carnauba shrinks when cooled, developing high internal stress resulting in a piezoelectric effect. This theory (if correct) indicates that certain kinds of glass should become electrets under proper treatment.

(Continued on page 82)

Electronic Visibililty Meter

This device measures the air's clearness

By S. R. WINTERS

INDICATING the approach of fog six hours before the human eye sees it, this device designed by the National Bureau of Standards is a promising safety device for airports. It also can give reliable indication of the lifting of fog long before the naked eye can detect such clearance. The device can likewise control glaring approach lights and fog-dispersal apparatus at airfields and may have many other uses.

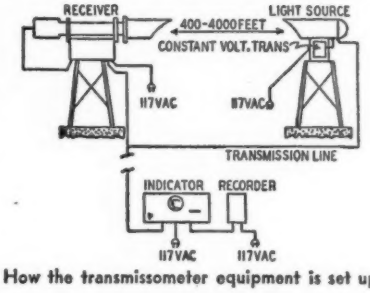
The Bureau of Standards calls this equipment a transmissometer. It is a four-in-one piece of apparatus—a light transmitter, a phototube receiver, an amplifier, and an indicator. This electronic gadget operates on the principle that the amount of light reaching the receiver from the transmitter is determined by the thickness of the fog or other obscuring atmospheric condition. The distance between the transmitter and receiver may be varied, but in practical tests good results have been achieved at ranges varying from 400 to 4,000 feet.

The transmitting unit has a 6-volt, sealed-reflector lamp, with a candlepower of 350,000, which differs from a sealed-beam headlight only in its cover and filament. The brilliancy of the light is controlled precisely by a voltage-regulating transformer. Adjustments are made by a series rheostat.

The receiver includes a lens, a diaphragm, a photo-pulse unit, and an amplifier. Light from the transmitter, focused by the lens on a pinhole in the diaphragm, falls on the phototube. The receiver develops voltage pulses at a frequency directly proportional to the intensity of the light falling on it. These pulses are amplified and sent over a signal line to the indicating unit. Frequency of these pulses ranges from 60 per second in fair weather to one every 20 minutes in thick fog.

The indicator consists of a two-stage amplifier, a frequency-measuring unit, and a calibrator. Since the latter operates from a standard power line, the calibration frequency is 60 cycles per second. The two-stage amplifier boosts and sharpens the incoming pulses, as well as cutting down noise picked up by the transmission line. The frequency meter levels and averages these pulses, thereby giving a reading directly proportional to the pulse frequency which is proportional to the transmission of the atmosphere between the light source and the receiving unit.

The indicator unit affords both dial readings and a record on a revolving drum, and can operate as far as 10 miles from the receiver. This flexibility

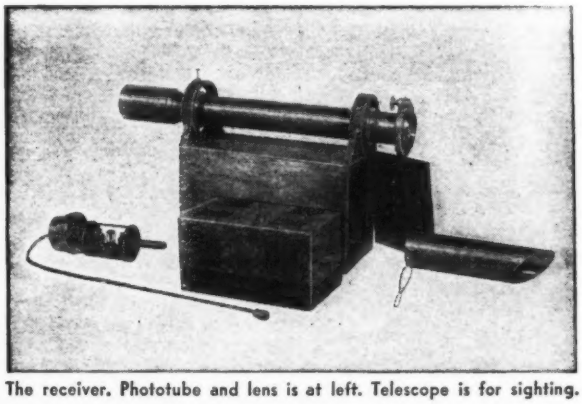


How the transmissometer equipment is set up.

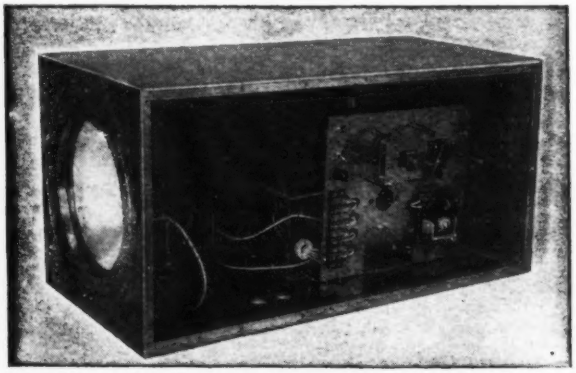
permits installing the indicator in the airport control tower and also the use of more than one transmissometer to "finger" across various sectors of the airport, while having the various indications converge at a single point for central observation.

Experimental units of the transmissometer are in operation in studies on fog-dispersal measures, glaring approach lights, visibility, and airport lighting equipment. Five are functioning at the Joint Landing Aids Experiment Station at Arcata, California. Others are in use at the Civil Aeronautics Administration's Experimental Station, at Indianapolis, Indiana, and at the Naval Air Test Center of the Bureau of Aeronautics, for visibility and airport lighting equipment tests; and at the Tiffany Foundation, at Long Island, N. Y., under guidance of the National Defense Research Council.

The Bureau of Standards lists six main uses for its electronic brain-child in aviation: (1) for controlling high-intensity apparatus; (2) as a supplement to routine visual observations by a continuous record of atmospheric conditions; (3) as replacement for visual observations where trained observers or satisfactory lights are not present; (4) as a means of giving accurate indication of visual ranges over a limited area remote from the observer, especially in an approach zone; (5) as a method of registering variations and rate of change conditions of visual range; and (6) to afford precise indications of the visual ranges when visibility is poor.



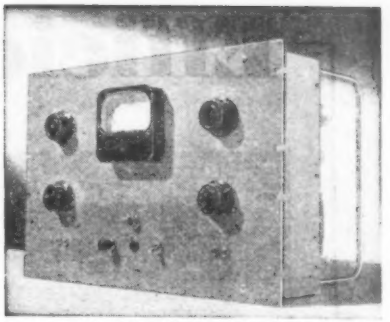
The receiver. Phototube and lens is at left. Telescope is for sighting.



Transmitter consists of an auto-type lamp and means of regulating it.

Noise Reduction In A. F. Circuits

By I. QUEEN, W2OUX



Courtesy Hermon Hosmer Scott, Inc.

A multi-tube commercial noise suppressor.

MODERN phono pickups, amplifiers and reproducers have excellent fidelity throughout the audio range. Unfortunately, hiss, scratch, hum and other background noises usually accompany the desired sounds to spoil what is otherwise life-like reproduction.

No circuits have been designed that can eliminate noise completely without affecting speech and music. It is possible to attenuate certain types of noise greatly with negligible effect on the signal. Two types of noise reducers are now used in high-fidelity phonograph reproduction and broadcasting. Each is capable of causing as much as 20 db drop in background noise.

Possibly the better-known type of noise control is the *Dynamic Noise Suppressor*. It is a development of Hermon Hosmer Scott, and is already in commercial use on a number of high-class audio amplifiers and radio-phono combinations. It is an electronic control that automatically adjusts the band width of an amplifier in accordance with the frequency of the incoming signal.

With no signal, two electronic gates limit the amplifier pass-band to about 250-1500 cycles. One of these limits highs, the other lows. Since hiss and scratch are high-frequency components and rumble and hum are very low-frequency noise, the amplifier will be quiet in this condition.

The high-frequency gate operates only on high frequency signals. This extends the upper limit of the amplifier pass-band. Low frequency signals operate the other gate to extend the low-frequency range. Between musical notes or words the band-width narrows again.

Dynamic suppressors are available in several models. They range from complicated 15-tube circuits for broadcasting to simple 3-tube affairs which give excellent noise reduction with good response for home phonograph reproduction. Fig. 1 is the schematic of the latter model.

The first tube is a 6SQ7 voltage amplifier whose diode plates are used to provide control voltages for the two 6SJ7 electronic gates. For convenience the diode plates are shown as independent rectifiers, D1 and D2. The triangular component of each rectifier is in each case the 6SQ7 cathode.

The first 6SJ7 is a capacitive-reactance tube. Condensers connected between its plate and control grid, and the high resistance between grid and cathode, cause the plate voltage to lag the plate current by 90 degrees.

Operation of the gates

The a.c. component of the 6SQ7 plate current flows through the control filter and high-frequency control circuit and is rectified by one of the diode plates (shown as the rectifying element D1). *Fundamentals* of desired high frequency components are filtered out and applied as varying bias to the control grid of the first 6SJ7. The filter allows only a narrow band of frequencies near 3000 cycles to control the high-frequency gate. This band was selected because it was found to contain the fundamentals of most of the high-frequency harmonics whose inclusion is desirable for good reproduction. If higher frequencies were permitted to operate the gate, the high-frequency noise itself would be able to open the gate. This of course would nullify the action of the circuit.

The parallel-tuned circuit L1-C6, the inductance L2 and the capacitive reactance of the first 6SJ7 comprise a low-pass filter. The varying grid bias causes a change in the tube reactance which changes the upper cut-off frequency. When this frequency is high enough, fundamentals and harmonics of high-frequency speech and music are transmitted through the amplifier.

The other 6SJ7 is connected as an inductive-reactance tube. This reactance —together with condenser C8 and the circuit capacitance—forms a high-pass filter with variable cutoff frequency, depending upon the instantaneous grid bias. The bias voltage is derived from D2, the second diode plate of the 6SQ7. After filtering, it contains only harmonics of low-frequency speech or music. Low-frequency noise such as rumble and hum do not operate the gate because these have negligible harmonics.

Several refinements are included in this suppressor. When S1 is opened, suppressor action is removed. S2 limits the amplifier frequency range for reproduction of very noisy records. S3 is a ganged push-button switch, added to demonstrate the effectiveness of the suppressor. When switched to B the circuit becomes a low-pass filter. High-frequency noise along with high-frequency sound components are attenuated.

Octave band transmission

Another noise reducer, associated with Harry F. Olson, of the RCA Laboratories, is simpler than the dynamic suppressor in principle and operation, and requires no tubes. However, special band-filters are needed.

Output from a pickup, microphone or other source passes through two rectify-

(Continued on page 62)

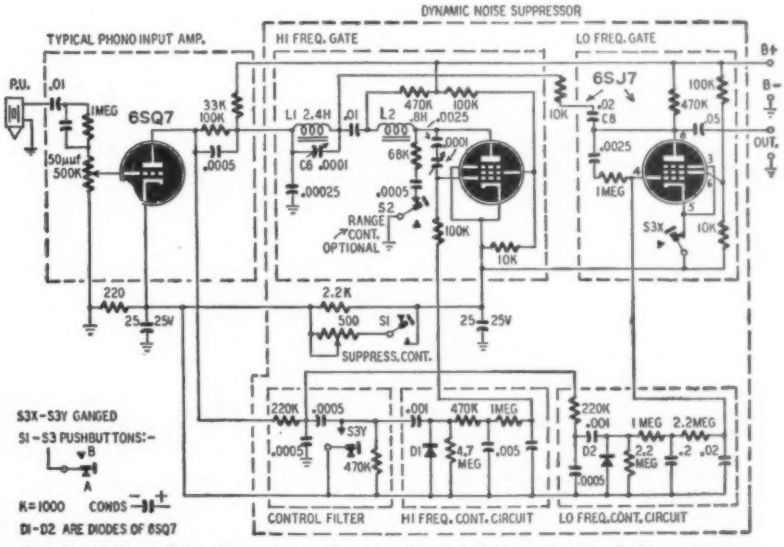


Fig. 1—High- and low-frequency gating circuits control the response of this suppressor.

Efficient 100-Watter

A transmitter which uses few tubes and components to achieve good results

By E. F. HARRIS, W8SJB

HERE is a 100-watt transmitter that has much to offer. It is simple and straightforward in circuit design and the almost miniature mechanical layout and the care taken to insure good looks has resulted in a unit which rivals professional models. The input power runs between 100 and 120 watts. If higher power is desired, this little unit is capable of pushing any final amplifier up to the allowable power limit on any band, from 80 to 10 meters. Because of this last feature, no modulator was included as an integral part of the transmitter.

To be compact, the transmitter had to be built around a physically small tube which could handle the required power input safely. An HK-24 was chosen for the job because it meets the requirements of size and power and is also very efficient at high frequencies. The other tubes are: 6L6 crystal oscillator, 5Z3 low-voltage rectifier, and two 816 rectifiers for the high-voltage power supply. A block diagram of the transmitter appears in Fig. 1.

The 6L6 in a harmonic oscillator circuit (Fig. 2) gives adequate output to drive the final amplifier on the fundamental, second, and fourth harmonics of the crystal. Feedback is obtained from the divider circuit formed by C1 and C2. Initially, C1 should be adjusted to give maximum output when the oscillator is used as a harmonic generator, and all that is necessary afterward is to choose the appropriate crystals and coils for the desired band and tune the plate tank to either the fundamental or desired harmonic of the crystal. The 60-ma pilot lamp in series with the crystal serves as a fuse to prevent crystal burnout. It should glow dimly when the oscillator is operating straight-through and should barely light or not light at all during harmonic operation.

Keying is in the oscillator cathode return to ground. The note is clean and free from clicks and chirps, even on harmonics. The .01 cathode condenser bypasses the r.f. to ground when the key is plugged into the jack. Omitting it will cause an appreciable loss of output, but, if c.w. operation is not desired, it may be omitted.

The oscillator is capacitance-coupled to the HK-24 final and provides sufficient drive on all bands. This type of coupling eliminates one tuned circuit, and is convenient to use.

The tank circuit of the final amplifier uses a 2,500-volt blocking condenser, which removes much of the danger of arcing in the split-stator tuning condenser. The neutralizing condenser is very small. It is actually one of the early disc-type neutralizing condensers designed for use with 6L6's. The disc plates are the size of a quarter, and proper neutralization takes place with the plates set from ½ to ¾ inch apart.

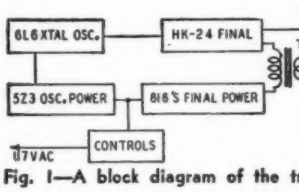


Fig. 1—A block diagram of the transmitter.

To avoid using fixed bias, a resistor is inserted in the filament return of the final amplifier. It provides sufficient cathode bias to limit the plate current to a safe value. This method is more convenient than battery bias, and the actual loss in plate voltage to the tube is less than 50.

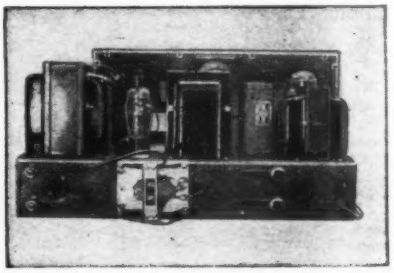
A multitap modulation transformer is mounted on the chassis between the oscillator and final amplifier power supplies. The transformer taps were selected to match the final amplifier's impedance (between 9,000 and 10,000 ohms) to a 500-ohm line. The 500-ohm line terminals are brought out to a 5-prong female connector at the rear of the chassis. With this arrangement any audio amplifier which can deliver about 30 watts and has a 500-ohm output connection may be employed.

In case a separate modulator is desired, the transformer may be used to match the impedance of the modulator tubes to the final amplifier. The transformer may be left mounted on the transmitter chassis and the modulator plate leads run to it through the 5-prong connector at the rear of the transmitter chassis.

The oscillator power supply delivers 350 volts to the oscillator under a load of about 60 ma. The bleeder resistor across the output also acts as a voltage divider to supply 250 volts to the screen of the 6L6.

The final power supply uses a pair of 816's in a full-wave rectifier circuit. The plate transformer's rating is 1,800 v.c.t. at 250 ma and the filter choke is also rated at 250 ma. Since the current drain is 100 ma under full load, the voltage at the plate of the final amplifier is slightly over 1,000 v (measured). The filter condensers are 8 μf, 600 working-volts each, and as the pairs are series-parallel connected they can easily handle the output of the rectifiers. A bleeder resistor is included to insure condenser discharge.

The metering and control circuits provide flexibility of operation, and the maximum utilization of the one panel meter. S1 is the a.c. line and filament switch. A 2- to 3-ampere fuse will, in the main line, give adequate protection. Switch S2 closes the center tap return of the high-voltage winding to ground



Compactness of the equipment is shown here.

in the oscillator power supply. It allows operation of the oscillator only when initially tuning up and also allows checking the frequency of the transmitter when listening to the receiver. Switch S3 is used in the initial tuning of the final amplifier. When it is on, a resistor is inserted in the primary lead of the high-voltage plate transformer to reduce the voltage on the HK-24 for tuning. It also energizes the relays Ry 1 and Ry 2. Throwing S3 to the off position after tuning has been completed shorts out the resistor and permits normal operation.

Switch S4 is the master send-receive switch. In the on position, high voltage is applied to the oscillator and power amplifier. It also connects the antenna to the transmitter (through Ry 2) and silences the receiver (through Ry 1). This system can readily be adapted to break-in operation.

S5 is a 2-pole, 3-position switch which connects a 150-ma meter across 50-ohm resistors inserted in the oscillator plate and final grid and plate circuits. The different currents may be read by merely rotating the switch to the desired position. The resistors do not affect the operation of the circuits in any way.

To neutralize the transmitter, turn it on and tune the oscillator to resonance. With the final plate voltage off, rotate the final plate tank condenser. If the HK-24 is not neutralized, the grid current will vary. Adjust the neutralizing condenser, and again rotate the tank condenser while watching the grid meter. The amplifier is neutralized when turning the tank condenser causes no change in grid current.

Table I
Oscillator Coils

Band (mc)	Turns	Diameter (inches)	Length (inches)	Inductance (μh)
3.5	25, No. 18	1½	1⅝	1.6
7	16, No. 16	1½	1⅝	5.7
14	8, No. 14	1½	1⅝	1.5
28	4, No. 14	1½	1½	.7

Or B & W JCL series

The HK-24 tank coil is designed to work properly into a low-impedance line. A doublet antenna fed with co-axial cable or a folded dipole fed by 300-ohm twin lead will give good results. In any case, the output of the transmitter may be link-coupled to a universal antenna tuner and used with any antenna. Coil data for the transmitter is given in tables I and II.

Table II
Amplifier Coils

Band (mc)	Turns	Diameter (inches)	Length (inches)
3.5	26, No. 14	3	4
7	20, No. 14	2½	4
14	10, No. 12	2½	4
28	4, *	2½	4

*⅛-inch copper tubing or B & W TCL series

Load the transmitter till the final's plate current reads 100 ma. The input is about 100 watts with this amount of current. The oscillator plate current should be about 50 ma and the HK-24 grid current between 20 and 30 ma.

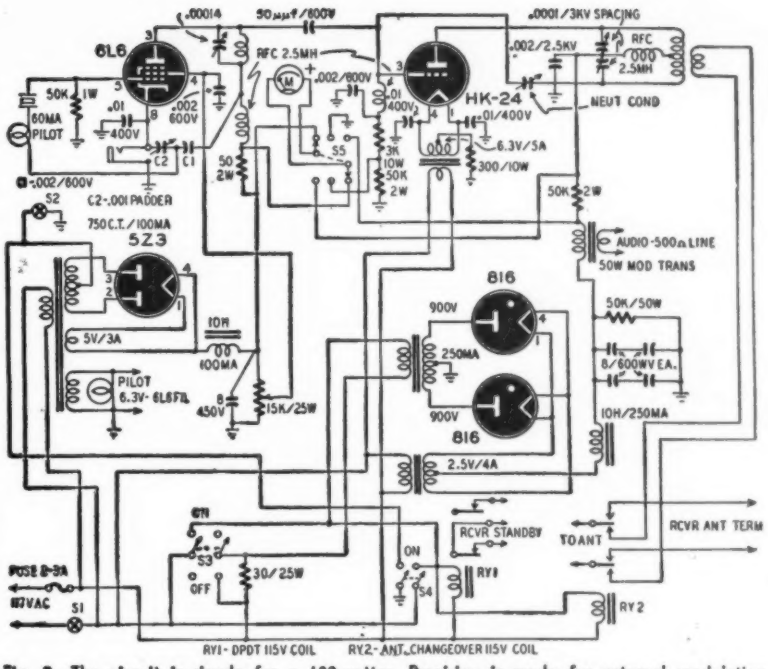


Fig. 2—The circuit is simple for a 100-watter. Provision is made for external modulation.

Amplifier Uses 6AD7 Inverter

THIS is the circuit of a good-quality phonograph amplifier with a total of 4 tubes. The amplifier uses a 6SJ7, a 6AD7, and a 6F6. The pentode section of the 6AD7 is driven directly by the 6SJ7 preamplifier. The triode section acts as a phase inverter and amplifier for a small portion of the signal from the 6SJ7 which it applies to the grid of the 6F6. Push-pull operation is thus obtained with a minimum of parts.

A low plate load resistor in the 6SJ7 stage insures good high-frequency response, and the 8-μf decoupling condenser provides a slight low-frequency boost as its increasing reactance increases the effective load resistance for these frequencies. Separate attenuators are included for adjusting the low- and high-frequency response. The .005-μf condensers from the output plates to cathode are for absorbing sharp peaks. A small amount of inverse feedback is provided by the 3-megohm resistors from the plates of the output tubes to the driving plates to correct any distortion in the output and to improve speaker damping.

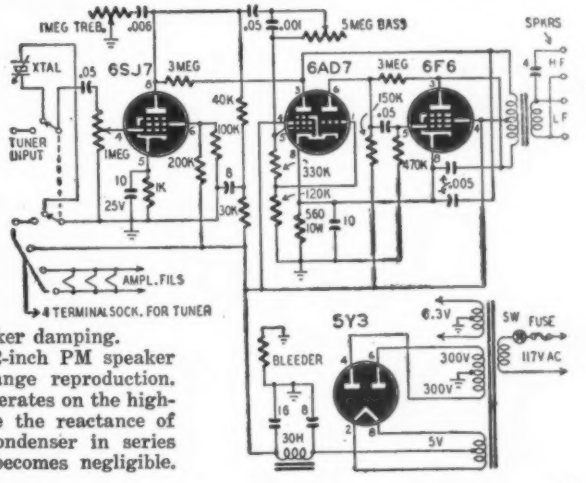
A 6-inch and a 12-inch PM speaker are used for full-range reproduction. The small speaker operates on the higher frequencies where the reactance of the 4-μf coupling condenser in series with its voice coil becomes negligible.

The output transformer has a plate-to-plate impedance of 10,000 ohms to match the impedance of the output tubes.

The tuner used with this amplifier is a conventional superheterodyne.

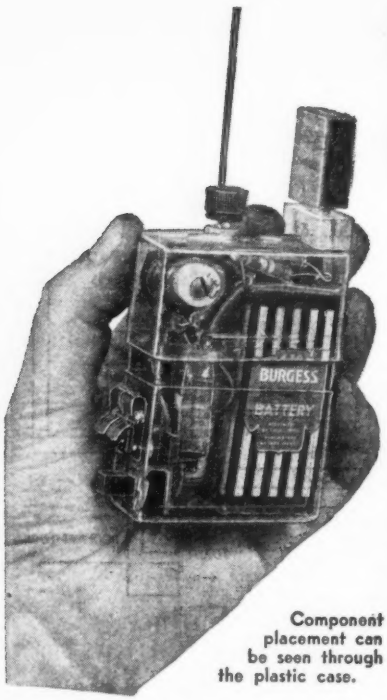
A d.p.d.t. switch is mounted on the amplifier chassis to switch the amplifier from the tuner to the phonograph pick-up as well as cut off the B-plus supply to the tunner.

Careful layout is important. The transformers are placed for minimum hum pickup, and filament leads are twisted and run in the angles of the chassis. All the ground leads from each stage are returned to a single point. To prevent feed-back the grid and plate leads are short and well separated.



Miniature 3-Use Fixed Oscillator

By WILLIAM LYON McLAUGHLIN



Component placement can be seen through the plastic case.

WITH so many monitors and signal generators on the market, this three-purpose oscillator makes its bid for fame only through its ultra-midget size.

As a simple signal generator, or as a monitor with phones in the circuit, it radiates a signal with terrific sock on any plate supply above seven and one-half volts. Its possibilities for c.w. with a key in the circuit are very interesting with B supply as high as 180 volts. The midget can also be used to calibrate crystals. The job has been tested on fundamentals and harmonics to 30 mc, so will obviously go much higher.

The circuit is the well proven Pierce oscillator, similar to the "CGQ" used by the U. S. Navy during the war.

The Raytheon CK-507-AX was chosen because of its small size as well as its output possibilities. The Burgess K20 B-battery was used because of space requirements. The little ceramic condensers were used for the same reason.

Requirement number one is a transparent, plastic, standard-brand cigarette case. Upon completion of the unit the case is not completely closed. The cover is permitted to overlap the body by a little over one-eighth of an inch. The two parts are held firmly together by drilling three small holes in the case and cover and fastening them with the smallest possible brass wood screws. No screw is used on the end where the B-battery is placed.

At one end of the cover, immediately above the B-battery, a plastic-bodied crystal holder adapter has been placed. Its contact pins have been cut down to about 5/16-inch in length. Three holes are drilled in the cover: two for the pins and one in the center for engagement. This last requires a matching hole to be drilled and threaded in the crystal holder. The author used a 6-32 screw which is screwed up from inside the cover.

The smallest possible r.f. choke is then mounted inside the opposite end of the cigarette case cover, as close to the top as possible. It is well to solder the 10-μμf condenser and the leads to the choke before mounting it in the cover.

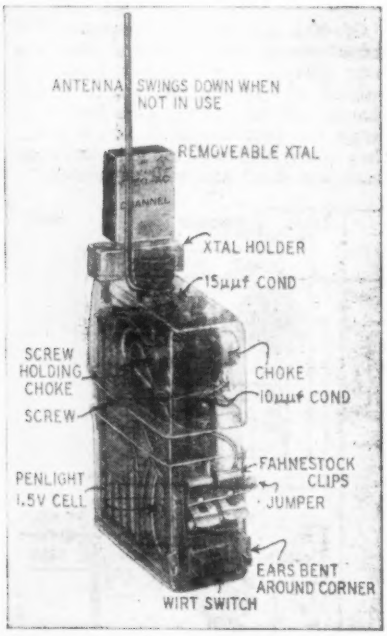
On one side of the cover, free from either the choke or the B-battery, a binding post is located. This supports the antenna, which is made from a piece of heavy wire shaped like an L, so that when not in use it can be dropped down alongside the case.

A Wirt sliding contact double-pole double-throw switch is mounted at one end, bottom, of the case, opposite the B-battery. The ears of the switch are bent ninety degrees to the body and drawn through slots cut through the end of the case as close to the side walls as possible. The ears are then bent around to hold the switch firmly against the case. Even though only one side of this switch is used it was chosen because it was the smallest available. It is well to remove the lugs on the unused side and then cut the remaining lugs down to a size that will permit soldering on the leads. To allow for the movement of the switch button an oblong hole one-half inch long and one-quarter inch wide must be cut.

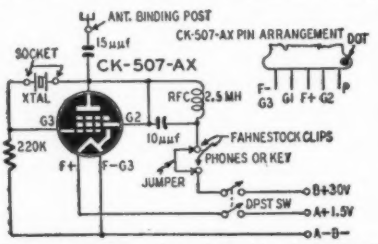
Two 3/32-inch holes are drilled 3/16 inch above the switch for the Fahnestock clips. The boss running up the end of the case will allow ample separation. As the width of the boss is about .08 inch the actual linear distance against current creepage is better than ⅛ inch.

The jumper can be made from a piece of hookup wire, twisted and soldered at one end to provide easy manipulation. This also permits attaching it to some point on the case to avoid mislaying it.

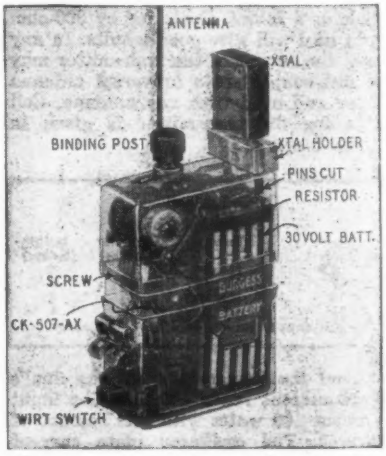
The tube pins are cut down to less than one-quarter of an inch. Pins P and G2 are soldered together. When assembly is completed the tube will be upside down next to the penlight cell and midway between the switch and B-battery. Care must be taken when closing the case to see that tube pins are kept about 1/32-inch from the lug of the choke.



The crystal oscillator as it appears in use.



Schematic follows that of the Navy's "CGQ."



All parts are referred to in the two views.

Laboratory-Type Oscillators

By WILLIAM B. MILLER

SOME oscillators for use in the laboratory are very elaborate, using 10 or more tubes, crystal control and regulated power supplies. A few are extremely simple, like the *Hummer* used to supply tone for an a.c. bridge. This is a tuning fork kept in operation by an electromagnet. The magnet current passes through the primary of a transformer, while contacts on the fork make and break the circuit.

A laboratory oscillator is required to have better than ordinary stability, freedom from unwanted harmonics, and as pure a sine-wave output as possible (unless special types of wave forms are needed for specific purposes).

An often overlooked cause of frequency shift is the relative phase of the grid-cathode and plate-cathode voltages. This relative phase shift—brought about by changes in tube electrode voltages—shifts the oscillator slightly off resonance so that the tank circuit may produce a compensating phase shift. Voltage regulation prevents this trouble. Other ways are equally effective and less expensive, although regulation is much used.

The tank circuit should have a low L-C ratio, and the grid and plate tuned-circuit inductances should have maximum coupling in feedback and Hartley circuits. Sometimes phase shift between the tube and tuned circuit occurs if grid or blocking condensers have insufficient capacitance or if shunt-feed chokes have too low an impedance.

Frequency also varies with temperature. For this reason tank circuits should not be close to large resistors or other heat-producing components.

The dynatron circuit

The dynatron oscillator (Fig. 1), if provided with automatic amplitude control, is an excellent circuit for laboratory use unless frequencies higher than 50 or 60 megacycles are wanted. It is a

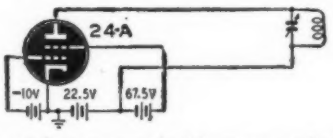


Fig. 1—Dynatron—early laboratory oscillator.

negative-resistance oscillator and depends on secondary emission from the plate for its operation. The screen grid is at a higher potential than the plate. In operation, an increase in plate voltage causes a decrease in plate current. This is a condition of *negative resistance*. Secondary emission from the plate creates this effect. The potentials on the grids (control and screen) control the number of electrons reaching the plate, while the plate voltage determines the velocity with which they strike it. The higher this velocity (within the practical limits of operation) the more secondary electrons are liberated by the primary electrons striking the plate. These secondary electrons are drawn to the more positive screen. The effective plate current is the difference between the electrons from the cathode and the secondary ones lost to the screen. When the secondary emission is greater than the cathode emission an increase in plate voltage may cause a decrease in plate current, a condition of negative resistance.

If a tank circuit whose parallel resonant impedance is greater than the actual value of the negative resistance is connected to the plate, oscillation will occur. The amplitude may be varied by changing the control-grid potential. By keeping the amplitude low, the harmonic content of the output wave can be kept small.

Transitron oscillator

Another type of negative-resistance oscillator, the transitron (Fig. 2), is an improved dynatron. The main difference is the use of the suppressor-grid.

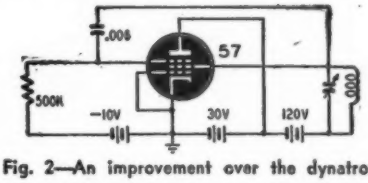


Fig. 2—An improvement over the dynatron.

It is negatively biased with respect to the cathode, and connected to the screen through a blocking condenser, so that its a.c. potential is the same as the screen's. A sudden increase in screen voltage raises the suppressor voltage, thereby permitting more electrons to go through it to the plate, usually maintained at a much lower voltage than the screen. These electrons are robbed from the screen current, with the result that the increase in screen voltage causes a *decrease* in screen current. If the screen (and suppressor) go negative, fewer electrons get through to the plate and more go to the screen. Again we have a condition of negative resistance, in which an increase in voltage causes a decrease in current, and vice versa.

Both the dynatron and transitron have frequency stability comparable to crystal-controlled oscillators that are not temperature-controlled.

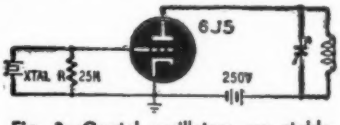


Fig. 3—Crystal oscillators are stable.

The best frequency stability is obtained with a crystal-controlled oscillator (Fig. 3).

Crystal oscillators

When a crystal is placed between two metal plates with a difference of potential applied to them, mechanical strains are set up in the crystal which cause it to produce an alternating voltage, of a frequency determined by the physical dimensions of the crystal itself. The bias resistor R in Fig. 3 controls the amplitude of the voltage through the crystal and prevents it from vibrating too violently. The Q of a crystal circuit is at

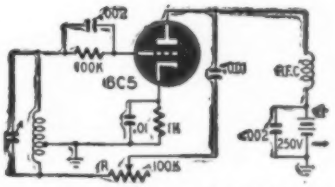


Fig. 4—The old familiar shunt-fed Hartley.

least 100 times that obtainable with commonplace capacitors and inductors. It therefore has a very sharp resonance curve, and it oscillates over only an extremely narrow range of frequencies. When its temperature is controlled with an oven, frequency variation can be kept within about two parts in ten million. Of course crystal-controlled oscillators can only be used for fixed frequencies.

A feedback oscillator is one that supplies its own input voltage of correct amplitude and phase. The Hartley (Fig. 4) is much used in the laboratory as it is easily adjusted, has excellent wave form, and oscillates over a wide range of frequencies. It is used particularly for audio and low radio frequencies. The tube, usually a triode, is operated as a class-A amplifier with self-bias.

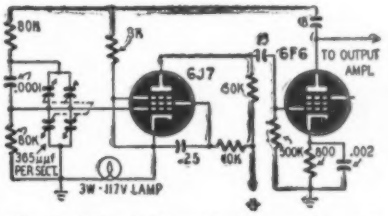


Fig. 5—Wien bridge; ideal for audio work.

R in this circuit is the resistance stabilization adjustment; it improves the frequency stability and wave form considerably at the cost of some reduction in efficiency. Since a change in the plate resistance of the tube causes a change in frequency, resistor R (usually from two to five times the value of the plate resistance) is high enough so that variations of plate resistance are of comparatively little consequence. Varying R controls the amplitude of oscillation.

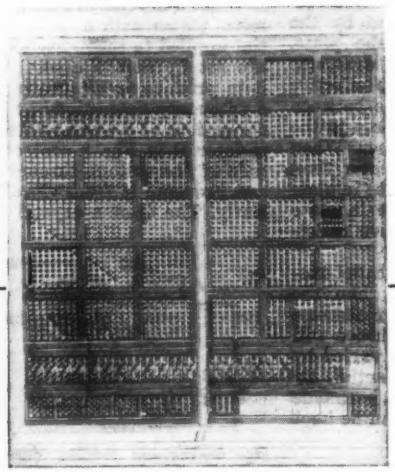
(Continued on page 72)

COVER FEATURE

12,000-TUBE ELECTRON BRAIN

A skilled mathematician with a desk calculator requires four years to do what the International Business Machines Calculator does in eight hours.

By A. PASCALE



Computer panels like these occupy more than 160 feet of wall space.

WOULD you like to compute the position of the moon involving the equations shown below in seven minutes?

EQUATIONS USED FOR COMPUTING THE POSITION OF THE MOON ON THE IBM SELECTIVE SEQUENCE ELECTRONIC CALCULATOR

t = NUMBER OF DAYS FROM DECEMBER 31, 1899

L = +0.75121 27392 0 + 0.03660 1↑020 28460 t
+ 0.00000 00000 00004 12965 t^2
+ 0.00000 00000 00000 00000 01077 t^3
+ 0.00001 10108 sin (0.53734 104 − 0.00001 01044 17 t
+ 0.00000 00000 00025 60 t^2)
+ 0.00000 06481 sin (0.14222 232 + 0.00000 15362 38 t)
+ [27 TERMS SIMILAR TO THOSE ABOVE]

D = [33 TERMS SIMILAR TO THOSE ABOVE FOR L]
l = [40 TERMS SIMILAR TO THOSE ABOVE FOR L]
l′ = [8 TERMS SIMILAR TO THOSE ABOVE FOR L]
F = [38 TERMS SIMILAR TO THOSE ABOVE FOR L]
θ_1 = [8 TERMS SIMILAR TO THOSE ABOVE FOR L]

LONGITUDE (= + 12960 00 L
+ [2369.902 + 0.00000 0294 t − 0193 θ_1 + 0.0012 sin (2D
+ 22639.500 (1.00000 2208) sin (l)
+ 769.016 (1.00000 2208)^2 sin (2l)
− 668 111 (1 − 0.00000 00683 20 t) sin (l′)
− 411.608 (1.00000 2708 + 139.978 θ_1)^2 sin (2F)
− 0.010 (1.00000 2208)^2 (1 − 0.00000 00683 20 t)^2 sin (2l + 3l′ + 2D)
+ [815 TERMS SIMILAR TO THOSE ABOVE]
+ 0.019 sin (0.84436 01544 + 0.00019 08338 8851 t)
+ 0.022 sin (0.62973 18211 − 0.06590 17070 2165 t)
+ [583 TERMS SIMILAR TO THOSE ABOVE]

θ_1 = + 22609.07 (1.00000 2208) sin (l′)
+ [194 TERMS SIMILAR TO THE ONE ABOVE]
+ 0.070 sin (0.13545 20294 − 0.09535 54072 5763 t)
+ [39 TERMS SIMILAR TO THE ONE ABOVE]

ΔLAT = [154 TERMS SIMILAR TO THOSE ABOVE FOR θ_1]
N = [12 TERMS SIMILAR TO THOSE ABOVE FOR θ_1]
+C = [146 TERMS SIMILAR TO THOSE ABOVE FOR θ_1]

LATITUDE (= + ΔLAT + (18519.750 +C) [(1 + 139.978 θ_1) sin (F + θ_1)
− 0.00033 6992 (1 + 139.978 θ_1)^3 sin 3(F + θ_1)
+ 0.00000 0216 (1 + 139.978 θ_1)^5 sin 5(F + θ_1)
+ 0.00005 3996 N]

sin (PARALLAX) = + 3422.7000 + 186.5398 (1.00000 2208) sin (l′)
+ [168 TERMS SIMILAR TO THE ONE ABOVE]
+ 0.0012 sin (0.72642 64891 + 0.03485 98579 9131 t)
+ [80 TERMS SIMILAR TO THE ONE ABOVE]

PARALLAX (= + (1 − 0.00004 6747) sin (PARALLAX) + 1/6 [sin (PARALLAX)]^3

SUMMARY OF OPERATIONS REQUIRED FOR COMPUTING AND CHECKING ONE POSITION OF THE MOON

DIGITS IN BASIC INPUT DATA AND INSTRUCTIONS	165,000
ADDITIONS AND SUBTRACTIONS	10,710
MULTIPLICATIONS	6,660
TABLE LOOK-UP OPERATIONS	1,870
LINES OF SEQUENCE INSTRUCTIONS REQUIRED	1,170
LINES OF SEQUENCE PERFORMED BY CALCULATOR	16,380

Yet it took only seven minutes, with the help of 12,000 electronic tubes, 21,400 relays and 40,000 pluggable connections, all at the disposal of the scientist, to work this problem on the *IBM Selective Sequence Electronic Calculator*. Without this machine it would have taken 3 weeks.

The entire machine is made up of card reading tubes, sequence tubes, sequence relays, table look-up (for consulting reference tables), relay memory, meters, control relays, power distribution, tape memory, arithmetical unit, sequence interlocks, electronic memory, printers, card punches, and card readers, in addition to the control desk and pulse generator shown on our front cover. These are all housed in a specially-designed room, 40.6 feet wide x 86.6 feet long x 14 feet high, the walls of which are completely lined with panels of vacuum tubes and relays. These walls—with a number of pieces of floor apparatus, such as printers and control consoles—actually *are* the machine.

The calculating element of the machine adds, subtracts, multiplies and divides the numbers it receives. The machine can make 3,500 additions or subtractions of 19-digit numbers in a second; 50 multiplications of 14-digit numbers in a second, and 30 divisions of 14-digit numbers in a second. It has a storage capacity of 400,000 digits in tubes, relays and punched tapes. When punched cards are used for storage the capacity of operation becomes virtually unlimited.

Operation of the machine

Instructions are given to the machine by the scientist on punched cards or continuous card-stock tapes. The tapes are prepared in one of two ways—either by the machine itself or with an auxiliary tape punch which transcribes data from punched cards. When the instructions are given on punched cards the numerical data is converted electronically from the original decimal form to the binary-decimal form in which each digit is represented by a combination of the binary numbers, 8, 4, 2, 1, used by all the new giant electronic calculating machines.

As soon as the numbers are converted to the binary system, masses of neon lights carry on a fire-fly flickering at stupendous speed, while very intricate calculations are being made within the machine. The innocent onlooker is virtually overwhelmed by this display.

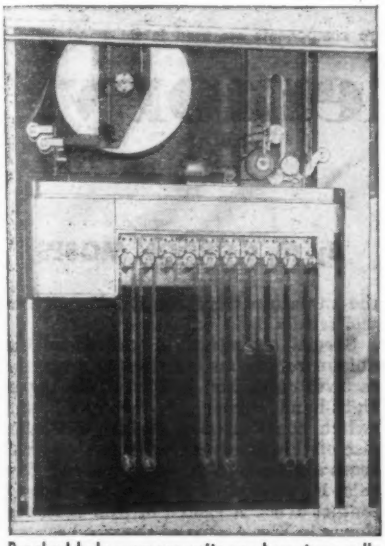
The machine follows the instructions on the cards or tapes and stores each intermediate result in a memory unit for later use in the course of the calculation. There are three means of storing numbers: electronic tubes (trigger circuits using 12SN7 tubes), relays and tapes. The relay and tape memory units are provided for general storage when large capacity is the dominant requirement. Electronic memory units are used in connection with the arithmetical unit where the need for speed predominates. But though the electronic system is more rapid, it cannot be used to the exclusion of tape and relay systems. If the present storage capacity of the machine, which is over 400,000 digits, were to be stored in electronic circuits it would be impracticable to house the machine in one building.

Not only does this machine add, subtract, divide and multiply, but it will also look up logarithm, trigonometric and other tables. If a table has to be referred to in the course of the calculation, the machine starts the tape of the desired table spinning. When the reference is reached, an electronic impulse stops it. The number then is stored in the memory section for future use.

The data for all computations and results obtained must flow to and from the arithmetical unit through any one of hundreds of channels throughout the machine, such as the reading and recording units and the great reservoir of stored results. Eight separate channels, each capable of transmitting simultaneously 19 decimal digits and an algebraic

sign, lead to and from the arithmetical unit. Traffic is directed along these channels to and from the other units by IBM electromagnetic relays. One of these relays, which is slightly larger than a conventional vacuum tube, can change twelve independent circuits in a few thousandths of a second. For some special problems it may even be desirable to change the whole mode of operation of the machine. This can be done in a few minutes by means of automatic control panels. About 40,000 pluggable connections on these control panels can be changed in units in a remarkably short time.

Problem results may be recorded either in punched card or in printed



Punched-hole memory units use long tape rolls.

record form, or if desired, in both forms. Since the machine is being utilized primarily for research purposes and because calculation proceeds at such a high speed, it is necessary that the scientists know at all times what results are being obtained, so that modifying instructions may be injected whenever necessary. Provision was made, therefore, for the continuous printing of results throughout the calculation.

The console, or operation indicator and control desk (shown on the front cover) is used for keeping a check on the operation of the machine. Have you stopped to consider what an immense servicing problem it must be to locate a burned-out filament in this maze of vacuum tubes? The control desk is useful for trouble shooting. If a tube burns out, or anything else goes wrong mechanically, neon lights in the panel on the control desk assist the operator in finding and diagnosing the trouble. A check is then made in the faulty section, the trouble repaired, and the machine goes on with its work. Of course, the trouble will be discovered only when the machine has to make use of that particular panel in the course of the calculation.

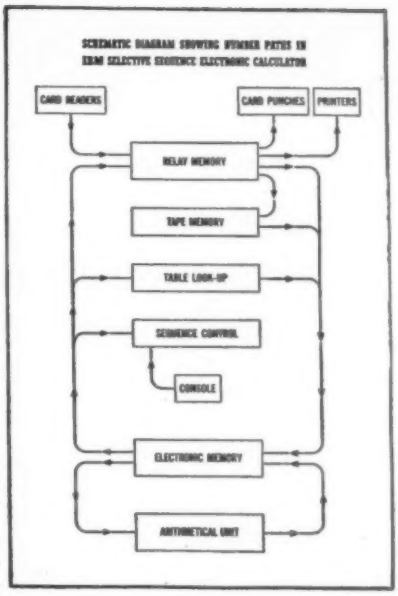
The machine requires 180 kilowatts of electrical energy. All the alternating current it uses is recitified by a large battery of rectifier tubes housed in cabinets in a room beneath the calculator. A large air-conditioning system is provided. It has a cooling capacity approximately equal to that required to air-condition completely a building containing 250,000 cubic feet of space. The system is capable of dissipating 200 kilowatts of heat.

The calculator is divided into three fire zones, each equipped with automatic temperature-detecting devices. Control of fire after detection can be either manual or automatic. Full release of the fire-extinguishing apparatus would discharge 32 tanks of CO_2 into the calculator units. The air conditioning and power supply would shut off automatically if gas were discharged. The instrument was built at a cost of $750,000.

Many branches of industry will be greatly aided by this machine. In certain commercial statistical fields calculations have to be made where complicated sequences of operations must be handled one at a time. The operations can be so speeded up as to perform calculations which now are considered impractical due to the amount of time that would be involved.

The scientist will be the one most aided by it. What once took scientists years upon years to work out, now can be done in a few hours, freeing him for further research.

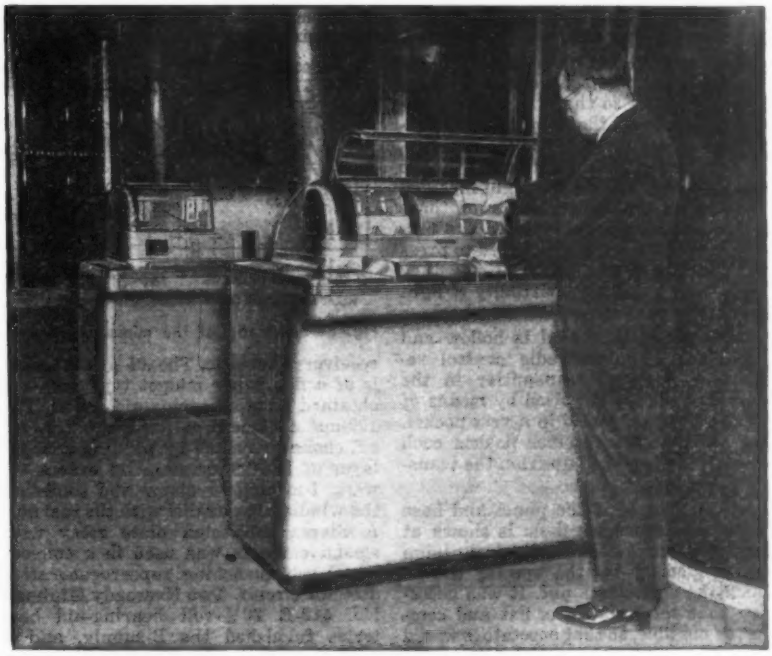
Greatest of all may be the effect of this new computer on the progress of atomic research. By performing the complex and laborious calculations required in the study of the atom, it will be a dominant factor both in keeping this country well ahead of all competitors in the military development of the atom and in speeding the day when atomic power will be available to peace-



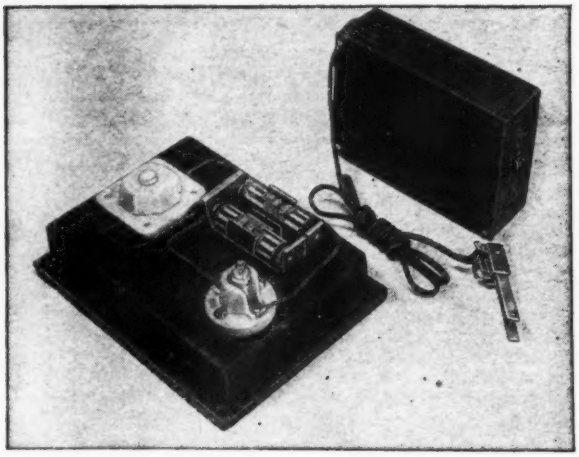
ful arts and industry.

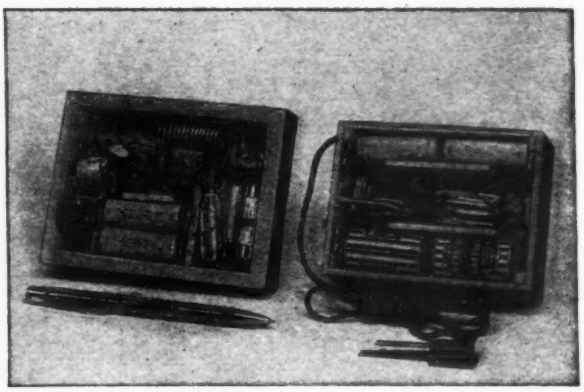
But, it cannot, and never will, replace the human scientist as its purpose is only to follow his commands. If the incorrect instructions are given to it, it will follow them. The scientist is supreme over the great electronic calculator, which is his child to assist him in exploring the ever-profound depths of science.

As President Thomas J. Watson of IBM said: "This machine will assist the scientist in institutions of learning, in government, and in industry, to explore the consequences of man's thought to the outermost reaches of time, space and physical conditions."



The card reader through which problems and instructions are introduced into the machine.





Left, Fig. 1—"The light with memory" and the secret transmitter.

Above, Fig. 2—Miniature components are used in the construction.

Light with a Memory

This remote radio control has several practical applications

By M. GORDON MOSES

IT has always been everyone's secret desire to press a button at one point and cause something to happen at another point. With the advent of radio control, this old dream became a reality. For example, model airplane construction has been combined with radio to produce remote-controlled planes which glide and turn in the sky —all at the whim of the operator on the ground.

An unusual application of radio control is the "light with a memory." The effect is startling even to those well-versed in radio. Briefly, the stage setting is this: A small wooden panel, with push-button, flashlight lamp, and batteries mounted on top, is shown. The batteries, push-button, and lamp are wired in series so that when the push-button is pressed the lamp lights. Pushing the button several times, say five, the "magician" waves his hand over the panel. Lo and behold! The light mysteriously blinks the same number of times as the miracle-w.rker pressed the button. Spectators are then allowed to press the button any number of times they desire, and the light—virtually a light with a memory—repeats the flashes!

The base of the panel is hollow and contains a complete radio control receiver. A compact transmitter in the operator's pocket is pulsed by means of a leaf switch concealed in a vest pocket. The lamp in the receiver flashes each time a pulse is picked up from the transmitter.

A photograph of the panel and base as the spectators see them is shown at the left in Fig. 1. The mechanical design was influenced by the special use to which the device was put. It was necessary that the unit be as flat and compact as possible, so that spectators would not suspect its existence. However, it is fundamentally a standard radio remote-controlled relay, and can be used in a variety of ways. The mechanical design can be modified to fit any particular application.

The push-button and miniature porcelain socket can be purchased in any electrical parts house, and the holder for the two penlight cells can be bought at a hobby supply store. The receiver with base removed is shown in Fig. 2, also at the left. Follow the placing of parts closely. The tuning coil consists of 14 turns of No. 14 tinned copper wire, wound to an inside diameter of ½ inch and spaced for an over-all coil length of approximately 1½ inches. Fig. 3 is the

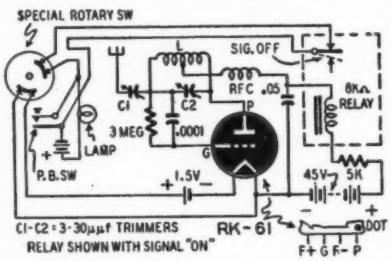


Fig. 3—Schematic of the miniature receiver.

receiver schematic. The .05-μf condenser is of a flat paper midget type and was obtained from a hearing-aid dealer. The 100-μμf condenser is a silver mica. An r.f. choke was made by winding a single layer of No. 32 enamel wire over a ¼-watt, 1-megohm resistor and soldering the winding in parallel with the resistor. A Sigma 8,000-ohm plate relay with s.p.d.t. contacts was used in a conventional self-quenching superregenerative detector circuit. Two Eveready Minimax No. 412-E 22½-volt hearing-aid batteries furnished the B-supply, and a penlight cell provided the A-supply for the miniature Raytheon RK-61 gas control triode.

Special attention is called to the unique rotary switch used to turn the receiver on and off. Shown in the upper right-hand corner of the panel, the switch consists of a ⅝-inch diameter disc of thin hardwood with two silvered brass segments glued on at spaced intervals. Four silvered brass wipers act as contact arms. A sketch of this switch is shown in Fig. 4. One of the wood screws used to hold the miniature porcelain socket on the panel is a dummy, and is actually used as a shaft to rotate the special two-circuit switch. One set of contacts goes to the filament circuit of the RK-61 tube, and the other set is in series with the contacts on the relay. Closing the rotary switch turns on the receiver and puts the relay contacts in parallel with the push-button switch mounted on top of the panel. More conventional switches are obtainable as band-change switches for short-wave receivers.

The antenna lead of the receiver is a 2-foot length of No. 22 d.c.c. magnet wire. Care must be taken not to bring any part of this lead too close to the tank coil and not to coil the antenna lead too much. The best arrangement is to run the lead around the inside of the hollow panel and bring the free end to

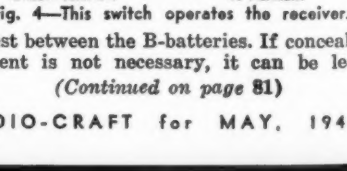


Fig. 4—This switch operates the receiver.

rest between the B-batteries. If concealment is not necessary, it can be led

(Continued on page 81)

Radio Set and Service Review

Midget television preamplifier

THE great popularity of postwar television has caused many sets to be installed in areas where signal levels are not high enough for clear, stable pictures. In some instances set owners are further handicapped by not being able to put up adequate antennas. Very often weak signals can be boosted to satisfactory levels by inserting a preamplifier between the antenna and the antenna terminals of the set.

Several television preamplifiers are being made by various manufacturers and a number of independent servicemen —all of whom treat their circuits as trade secrets. All these preamplifiers use one or more stages; some require tuning and others do not. Many of these boosters, like the one we are about to describe, were designed from material appearing in the article, "Cathode-Coupled Wide-Band Amplifiers," in the October 1945 issue of the *Proceedings of the I.R.E.*

Under-chassis view, showing part placement.

Our booster, a 6J6 grounded-grid amplifier designed to operate on channels 1 through 6, amplifies the antenna signal two to four times while providing a substantial improvement in signal-to-noise ratio. It has several advantages. It does not require manual tuning; it is small enough to fit on the chassis or inside the cabinet of almost all television receivers and it does not require a special power supply.

The grounded-grid amplifier

The grounded-grid amplifier used in this circuit was developed to avoid neutralization when using high-frequency triode amplifiers. (See *Radio-Craft*, Nov., 1947, P. 32). The input signal is applied between cathode and grid, and the output voltage is developed across a load between plate and grid. The grid, either grounded directly or through a suitable bypass condenser, acts as a shield between the input and output circuits, thus forestalling oscillations until the input frequency is so high that the grid lead has appreciable impedance.

The grounded-grid amplifier has several advantages, which make it useful as an untuned r.f. amplifier between the antenna and televiser. These are: Lower tube noise, output capacitance less than one-half of that of a conventional neutralized amplifier, and low input capacitance—a necessity for high transconductance. The low input and output capacitances result in greater band-width without manual tuning.

Construction

The circuit of the grounded-grid preamplifier is shown in Fig. 1. It is constructed on a chassis 2½ inches square and 1 inch deep. The three terminal strips are for input, output and power connections. Filament and plate voltages are taken from the low-voltage supply of the set.

The tube is a 6J6 with its triodes connected in parallel. The cathode and plate coils are wound so that combinations of distributed and circuit capacitances tune them to cover the first six television channels. The antenna transformer is mounted on a bracket near the input terminals. The output transformer is fastened to the chassis with a machine screw threaded into one end of its form.

The primary of the antenna transformer is designed to match a 300-ohm balanced transmission line. It is an 8-turn winding tapped at the center. The cathode coil has five turns interwound with the primary. The output transformer has a 10-turn plate winding with a 2-turn output link interwound at its lower end. Both transformers are wound with No. 34 enamel wire on 5/16-inch polystyrene tubing. All coils are close-wound. Use 300-ohm twin-lead between the preamplifier and the antenna terminals of the set.

The unit is so simple as to make it unnecessary—and almost impossible—

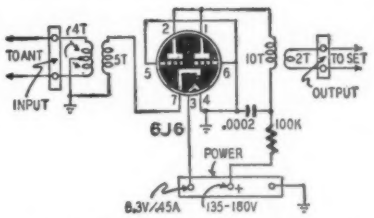
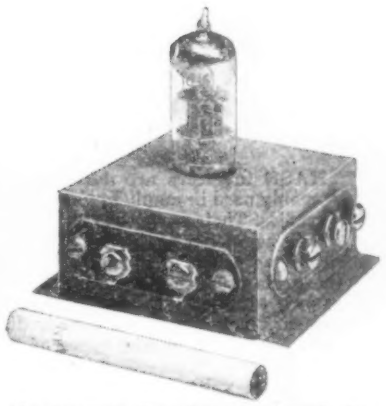


Fig. 1—The grounded-grid circuit is used.

to give any further construction details. An almost slavish adherence to original RCA development illustrated in the I.R.E. *Proceedings*, in regard to placement of parts, size of chassis and manner of making connections has been observed in more than one successful model. The constructor would therefore probably be well advised to follow the photograph closely—at least in his first model.

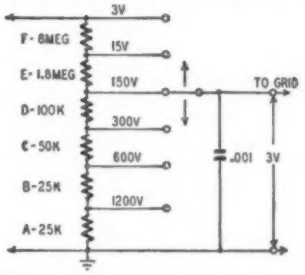


The preamp's dimensions are cigarette-size.

V.T.V.M. CALCULATIONS

THIS method of calculating the resistance values in a voltage divider may be useful to the serviceman who wishes to build his own vacuum-tube voltmeter.

As an example, assume that the desired ranges are: 3, 15, 150, 300, 600,



and 1,200 volts; the total input resistance is 10 megohms; and 3 volts are required on the grid of the tube for full-scale deflection. For the 1,200-volt scale, divide 1,200 volts by 10 megohms to find the current through the resistor A:

1,200/10 meg = .00012 amp.

Dividing the 3 volts (required for full deflection) by .00012 amp gives the resistance as 25,000 ohms. This is the value of resistor A.

For the 600-volt scale, the procedure is the same:

600/10 meg = .00006 amp (through resistor B).

Three volts divided by .00006 amp shows the resistance to be 50,000 ohms, which is the value of B plus A. Subtracting the value of A from 50,000 gives B as 25,000 ohms. By repeating the same procedure the remaining resistors are:

Scale (volts)	*Resistor*	*Value*
300	C	50,000 ohms
150	D	100,000 ohms
15	E	1.8 megohms
3	F	8 megohms

The total resistance is 10 megohms.

Phase Inversion Circuits

Part I—The transformer type of inverter, with some variations on standard circuits

By J. W. STRAEDE*

PHASE inverters are devices commonly used in amplifiers and large radios. Their purpose is to provide two equal but antiphase alternating voltages which are usually applied to the grids of push-pull output tubes. They are also used in electronic test equipment, including watt-meters, distortion meters and special types of oscilloscopes.

The signal voltage required by the following stage and the suitability of the system for use with negative feedback, are among the several factors that must be considered in the choice of a phase-inverter circuit. Power may also be required by the output tubes, as in class-AB2 operation, and, finally, the cost may override all other factors, no matter how desirable they might be.

Phase inverters are classified according to the way the signal voltages are fed from one stage to another. Classifications are: (1) Inductively coupled, (2) Resistance-capacitance coupled, and (3) Direct coupled.

The oldest form of inductively coupled phase inverter is the transformer with a center-tapped secondary, or with two secondary windings—one for each grid. Other inductive systems use a center-tapped choke coil, and a transformer with no center tap but with the secondary voltage divided by a pair of equal resistors. These three circuits are shown in Figs. 1, 2, and 3,

Transformer coupling

Biggest drawbacks to the use of transformers are their cost, liability to hum pickup, and imperfect frequency response. Hum can be reduced by mounting them away from power transformers and chokes and by rotating them until a position of minimum hum is found. High-frequency peaks can be reduced by shunting the secondary with resistors (about ½ megohm), while things can be improved generally by using negative feedback in the driver stage.

Fig. 1—Standard transformer-coupled circuit.

Advantages of transformer coupling are the large signal voltages obtainable, the low d.c. resistance in the grid circuits of the output tubes and its adaptability for class-AB2 operation. In this case, the transformer usually has a step-down ratio to match the minimum grid input resistance of the next stage to the plate resistance of the driver. (Grid input resistance varies from values too large to bother about when the grid is negative to values as low as a few hundred ohms when the grid is very positive.)

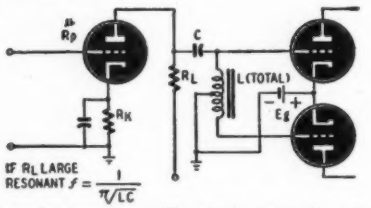


Fig. 2—Inversion with single tapped coil.

The gain M of the driver and the transformer is nearly equal to the product of the amplification factor and transformer ratio. The optimum grid bias is $\frac{2}{\pi}$ times the plate voltage divided by the amplification factor.

The center-tapped choke is a comparatively inexpensive device, but is full of faults, such as unbalance at very high frequencies, low response at very low frequencies, and low voltage output. It is still useful for compact car radios and small mobile amplifiers where only a limited frequency range is required. A good quality center-tapped output transformer can be used with fair results if it has enough inductance.

The low output voltage is due to the voltage drop across RL (Fig. 2), together with the drop in effective load impedance also caused by RL. If RL is decreased to avoid the first defect, the second defect becomes more pronounced. At medium to high frequencies, the gain M approaches

$$\mu\left(\frac{RL}{RL + Rp}\right)$$

where μ is the amplification factor of the tube, RL is the load resistance, and Rp is the plate resistance. The bass resonant frequency is given by

$$f = \frac{1}{\pi\sqrt{LC}}.$$

The gain then is

$$\frac{\pi f L \mu}{2Rp},$$

where L is the inductance of the choke in henries, and C is the capacitance of the condenser in farads.

Transformer with resistors

A transformer with resistors (Fig. 3) is often used as a makeshift, but is quite capable of good gain and frequency response if the output tubes require no driving power and if high grid-circuit resistance is permissible. The two resistors must be as nearly equal as possible and must be large to prevent high-frequency loss in the transformer and to present a reasonably large load impedance to the driver tube. This impedance is given by $\frac{2\,Rg}{n^2}$, where n is the step-up ratio of the transformer. The gain to each grid is then $\frac{n\mu\,Rg}{2\,Rg + n^2 Rp}$.

If the driver is a low-impedance tube such as a 6C5 and the grid resistors are each 0.5 megohm, the gain is very nearly equal to nμ at mid-frequencies. At low frequencies the gain is 3 db down when the reactance of the transformer primary is equal to the plate resistance of the driver.

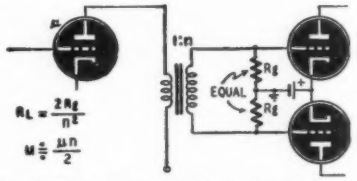
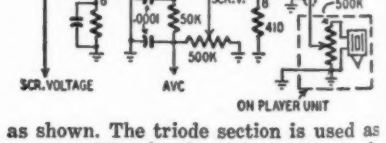


Fig. 3—How an untapped condenser is used

A second article by Mr. Straede, in an early issue, will cover resistance-capacitance types of phase inverters.

PHONO PREAMPLIFIER

I have a small superheterodyne using a 6A8, 6B7, 6K6, and rectifier. I tried unsuccessfully to add a phono attachment by connecting it to the grid of the 6K6. The output of the pickup was too low for use without a preamplifier. I removed the 6K6 and wired in a 6AD7



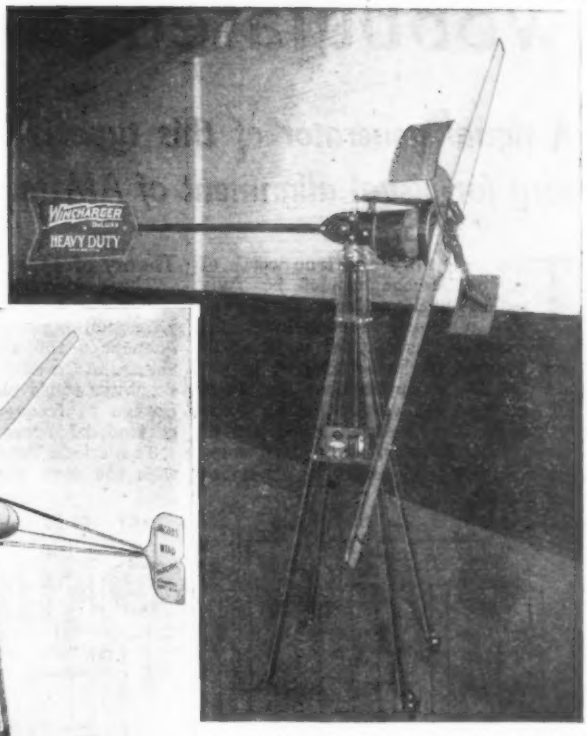
as shown. The triode section is used as a preamplifier for the pickup without altering the performance of the set.

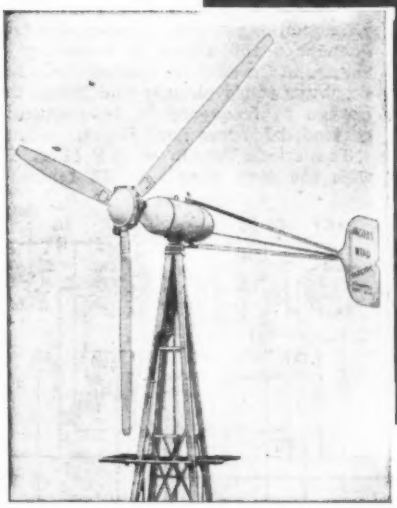
JOSEPH PRITCHARD,
Hamilton, Ont., Canada

*Lecturer in electronics and electro-acoustics, Melbourne Technical College, Australia.

Servicing Wind Generators

By MAX ALTH





Above—The Wincharger; left—Jacobs Wind Electric, two common battery-charging units.

THERE is little chance that one of us will ever be called on to service the 1,000-kw giant wind generator atop Grandpa's Knob near Rutland, Vermont. But we *will* be called upon sooner or later to service one of the more than a million wind-driven power plants in use today.

Wind-generator servicing is not hard. After the tower has been climbed, there is really nothing to worry about. These generators are very similar to automotive generators. In fact the first units, some of which are still being used today, were auto generators.

If called upon to install a plant, select a spot as close to the load and as unobstructed as possible. The prop on a 6-volt machine should be mounted at least 15 feet higher than any obstruction within a radius of 500 feet. The larger, 32-volt job requires a clearance of at least 30 feet above anything within ¼ mile. Higher up the air is smoother and will develop more power. Raising the *Wincharger* Model 3227 from 65 feet to 105 feet has been found to increase the power output 30%.

Since the lines from generator to load carry high current at low voltage, they should be kept as short as possible from the point of view of both voltage drop and wire cost. A 32-volt line carrying 40 amps should be at least No. 6 wire if it runs 100 feet, and No. 4 if it runs 200.

The tower should be erected plumb so that the generator doesn't tend to fall off to one side. It should be well grounded as otherwise it would be a natural target for lightning.

After the unit has been erected, the prop should be checked for balance and track. On a *windless* day, remove the brushes or tie them back with a piece of string, and give the prop a quarter turn, then another. If the same blade comes to rest in the down position every time, the prop is unbalanced.

Correct unbalance by loosening the prop in its haft or holder, and wriggling. If there isn't enough play for correction, drive a wood screw into the lighter arm. First locate the balancing spot for the screw by temporarily fastening the screw to the prop with a piece of adhesive tape. If the screw has to be more than 2 feet from the center, it's best to locate a better-matched pair of prop blades. Some props are equipped with counter balancing weights. An out-of-balance prop will vibrate the plant and shorten its life considerably.

Check the track by measuring carefully from inner edges of each blade, from equidistant points from prop end back to a fixed point on the tower. Correct by again wriggling prop, or by slipping a shim between prop and haft. Out-of-track blades make whistling noises and reduce prop efficiency.

Be sure the unit is lubricated before placing in operation; some of these units are packed and shipped dry.

Now let her go and watch the voltmeter. If it reads backward, or if the relay chatters, disconnect before relay is injured. Your wires may be reversed. If the wiring checks O.K., the polarity of the unit may have been reversed at the factory. Run the generator as a motor for a few minutes by connecting the storage battery to it. In some cases closing the relay by hand will make this connection; in others it will have to be done with a jumper. Check the diagram furnished with each generator first. A typical 32-volt hookup is shown in Fig. 1—the 6-volt jobs are even simpler.

Motoring the generator will not only correct the polarity of the generator but will also give you a general idea of the condition of the unit, whether or not the circuit is complete, etc.

Servicing established units

Complaints fall into 2 general catagories: lack of immediate power, or insufficient power over a period of time.

If there is no power, first check the controls for proper adjustment, then run an ordinary continuity check up the leads through the slip rings and slip-ring brushes to the generator proper. Check the position of the third brush, if the model has one. The brush may have slipped back. Check the other brushes for seating and tension. The commutator should have a dull-brown oxide sheen. If it is lightly scored, it may be repaired by holding sandpaper against the commutator and turning it. If the commutator is deeply scored, it will have to be turned down on a lathe. Light or deep scoring indicates hard spots on the brushes. They should be

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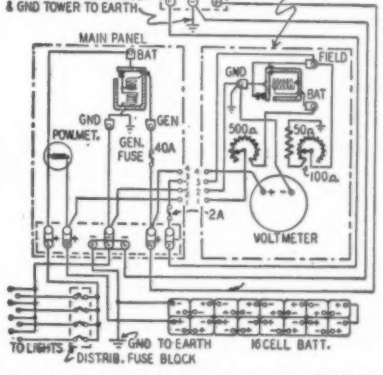

Fig. 1—Circuit of the Wincharger Model 3227.

Wobbulated Signal Generator

A signal generator of this type is necessary for visual alignment of AM receivers

By GEORGE W. SCHULTZE

THE versatility and true worth of an oscilloscope cannot be fully realized until you have actually had such a device on your bench for some time and used it for servicing or development. Perhaps the most important of these applications is visual alignment of receivers, requiring a frequency-modulated sweep generator or "frequency wobbler." The frequency-modulated signal generator described (Fig. 1) for use in alignment of AM receivers was developed and constructed by the author.

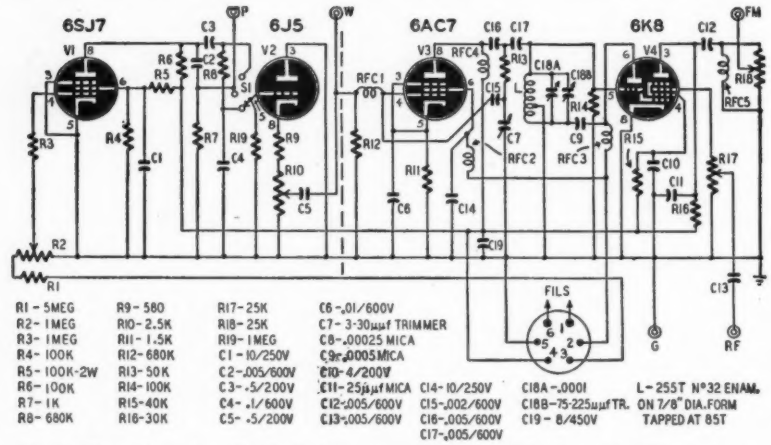

Fig. 1—Generator schematic. Radio-frequency chokes are of the large 60-millihenry type.

The following specifications were set up:

1. A center frequency variable from approximately 450 to 540 kc, giving an easily adjusted carrier frequency covering the i.f.'s of practically all modern AM receivers.

2. Frequency deviation adjustable from 0 to 30 kc. Such a maximum deviation will project the response curves of the i.f. and r.f. transformers in all AM receivers (including the high-fidelity ones) to zero response both sides of maximum.

3. Unit must be compact. Such a characteristic becomes a virtue on the average service bench.

4. Cost must be kept to a minimum.

5. Unit must be adequately shielded (as all good r.f. signal generators should be) to avoid radiation of unwanted signals to other equipment.

A separate power supply, connected to the wave generator by a multiconductor cable, was considered desirable. First, magnetic shielding is simplified. Second, by making the unit a universal power supply, it becomes an extremely useful tool for other activities as well.

Theory of operation

Three operations are carried out in the frequency-modulated oscillator. An r.f. signal is generated; second, the frequency of the signal is varied by a change in the effective inductance in the oscillator tuned circuit; and third, the change in frequency is automatically controlled between fixed limits.

The triode section of V4 (Fig. 1) with the tank circuit L-C18 forms a simple Hartley r.f. oscillator. For a detailed account of the theory of operation of the reactance tube V3, the reader is referred to any of the standard texts. We can simply say that varying the control grid voltage of the reactance tube controls its effective inductance and, consequently, the oscillator frequency. If a low-frequency alternating voltage, say at 60 cycles, is applied to the control grid of the inductance tube, the output frequency from the oscillator will swing from a maximum to a minimum value, and back again, 60 times a second. It is desirable that the frequency change be linear to time. Such a triangular or "pyramid" wave (Fig. 2) is obtained across the integrating circuit R8-C4 (bottom tap on switch S1). The output from V1, a sine wave clipped to an approximate square wave (Fig. 3), appears at top tap of S1. The pulse formed across the differentiating circuit R7-C2 is available at point 2 of S1, and at the PULSE binding post (see Fig. 4).

V2 is merely a cathode follower buffer stage, and the hexode section of V4 is a mixer for injection of a fixed frequency signal when desired.

How generator is used

In visual alignment, the same series of steps are followed as are used in the output meter method. The output of our wobbler is injected into the receiver at the usual points instead of the fixed frequency signal, and the oscilloscope takes the place of the output meter. The oscilloscope should be connected across the detector load rather than across the output transformer. The pulse output is connected to the external synchronization post on the oscilloscope. The oscilloscope horizontal sweep is set for 120 cycles per second, which results in the trace from maximum to minimum frequency being superimposed upon the trace from minimum back to maximum.

The center frequency control C18a is adjusted to the required center frequency. R2 is set at about two-thirds maximum. R10 is set at or near maximum. If the i.f. stage being checked is considerably out of line, the double-trace response curve will appear as in Fig. 5. As the trimmers are adjusted to bring the transformer into alignment, the two traces will coincide, or approximately so, as shown in the oscillogram (Fig. 6). The shape of the response curve in the usual properly aligned transformer is of this general outline with a single smooth peak. High-fidelity receivers will have curves with a flat top or double peaks. During the above operations the frequency deviation control R10 should be adjusted to give a reasonably wide response curve without cutting off the ends.

The FM test signal is injected at the conventional points for checking the oscillator and r.f. circuits of the receiver. To obtain the necessary broadcast frequencies, a fixed-frequency signal from a conventional test oscillator is mixed in V4 with the FM signal to give the desired difference frequency. The response curves will be similar to those obtained from the properly tuned i.f. stages. The oscillator and r.f. adjustments are made for maximum height of response curve.

Whether the response curves will appear on the oscilloscope screen right side

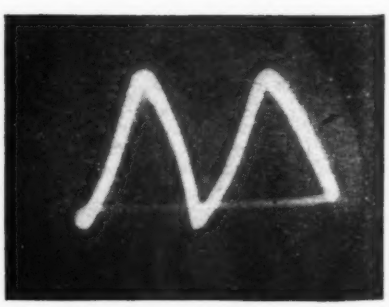

Fig. 2—Normal pyramid (time-linear) wave

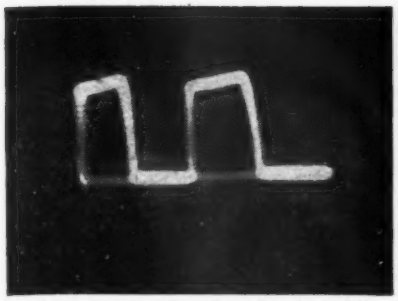

Fig. 3—Square waveform from the plate of V1.

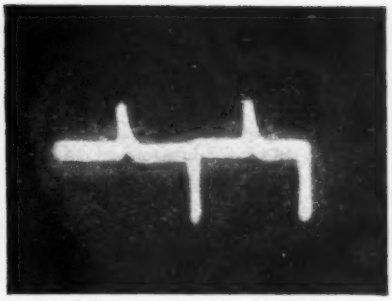

Fig. 4—Differentiated pulse output from V1.

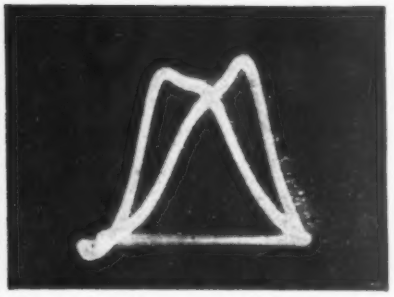

Fig. 5—Trace from a misaligned i.f. circuit.

up as shown in the oscillograms and drawings in this article, or upside down, depends upon the number of stages in the oscilloscope vertical amplifier, the orientation of the cathode-ray tube, and at what point in the receiver the test signal is taken off.

Construction

The FM signal generator was designed to go into a 7 x 7 x 7-inch enclosure. The low-frequency portion (6SJ7 clipper and the 6J5 buffer) is mounted in a 1½-inch deep horizontal steel chassis. The r.f. section, including the sockets for the 6AC7 reactance tube and the 6K8 mixer, is contained in a 2½-inch deep sheet-copper chassis, mounted vertically on the back edge of the steel chassis. This is clearly shown in the photographs (Figs. 7 and 8). The copper box is bent from 22-gage sheet, and the joints soldered. A copper back cover is secured with self-tapping screws. The same type of fastening is used to join the copper shield box to the bottom chassis. The panel can be either bakelite or (as shown) crackle-finish Masonite, 7 x 7 x 3/16 inches.

The power input socket, the binding posts, the potentiometers R2 and R10, and switch S1 are all mounted on the panel, as pictured below. The center frequency adjustment C18a and potentiometers R17 and R18 are located in the copper shield box with extension shafts extending to knobs on the panel. C18a must be insulated from the chassis by fiber washers, and the shaft couplings should be insulated. The five binding posts provide connections on the panel for the FM output, r.f. input (constant frequency generator), ground, 60-cycle wave, and pulse. The 60-cycle wave post provides a convenient connection for checking the output of the clipper circuit, as well as affording access to the three types of wave form, as selected by S1, for other fields of use. As mentioned before, the pulse output is used to synchronize the time base sweep of the oscilloscope.

V3 and V4 are either metal tubes or externally shielded glass types. If metal tubes are used, be sure to ground the No. 1 pins (internal shield). This is especially important for the 6K8 mixer. The phase-splitting condenser C7 is fastened inside the top edge of the copper box with a hole provided for external screw-driver adjustment. The center frequency range adjustment C18b is mounted to allow trimming through a hole in the back cover.

Bare, tinned wire is best for most of the r.f. wiring. All leads should be as short and direct as possible. All ground leads from V3 and V4 are brought to common single chassis connections. The tank coil L was wound on a ⅞-inch outside diameter plastic cylinder 2½ inches long. The base end of the form was plugged with a wood disc cemented in place. A hole for a 6-32 screw was drilled through the center of the plug and a hex nut cemented on the inside. The coil was then mounted on the side of the copper shield box with a counter-sunk head machine screw. The lead from R18 to the panel binding post was shielded in order to avoid low-frequency pickup. The 60-mh choke RFC5 filters out any 60-cycle

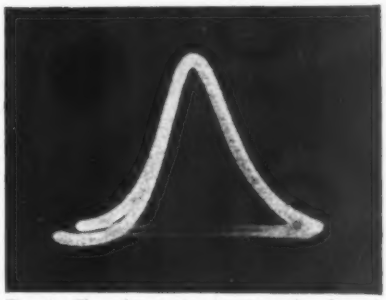

Fig. 6—The above circuit, properly aligned.

amplitude modulation present in the output from V4.

The panel is backed by an iron shield which provides an anchorage for the sheet-iron cover as well as magnetic

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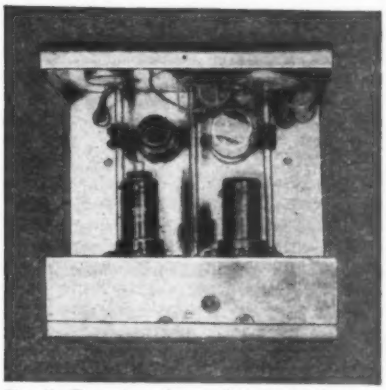
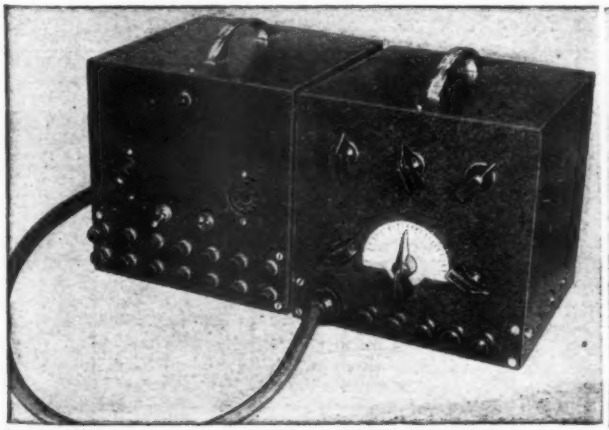


Fig. 7—Top view shows placement of parts.



Instrument and power pack present a pleasing uniform appearance.

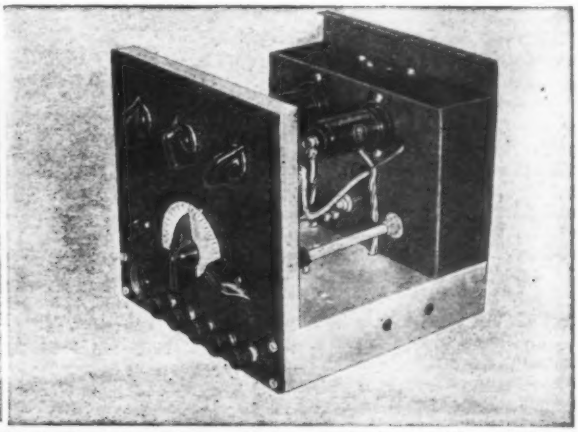
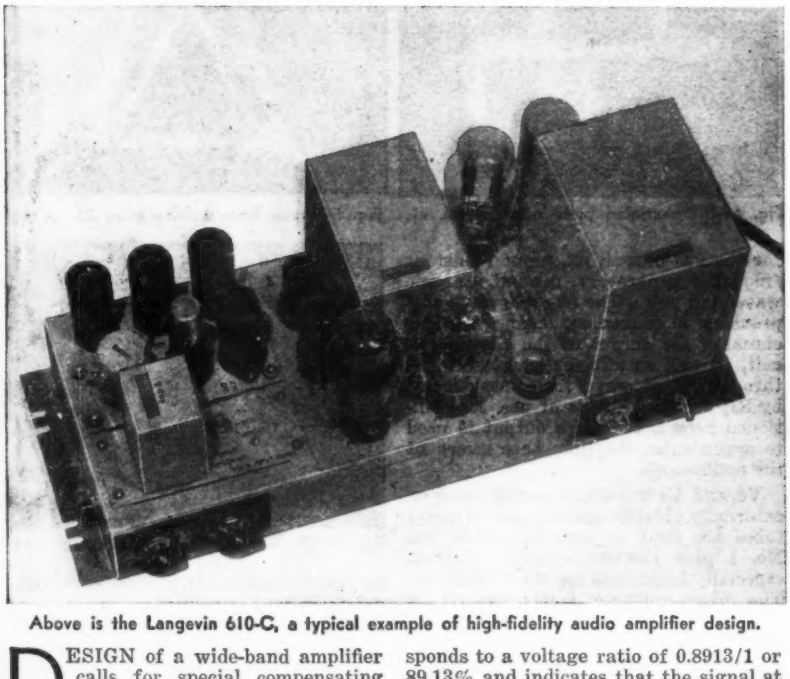


Fig. 8—Front view. Tubes mounted on subchassis are 6AC7 and 6K8.

High-Fidelity Amplifiers

Second of a series on wide-band amplifier construction

By ROBERT F. SCOTT



Above is the Langevin 610-C, a typical example of high-fidelity audio amplifier design.

DESIGN of a wide-band amplifier calls for special compensating circuits to offset the drop in response at the high and low ends of the audio spectrum. As pointed out in a previous article (March, 1948), response begins to drop off noticeably at the high end of the band when the shunting capacitances present a reactance about five times as great as that of the plate resistance and the coupling and load resistors in parallel. Additional losses due to degeneration in cathode and screen circuits can also occur.

These factors can be compensated for by careful design. Assume that an audio amplifier is to be designed to deliver 3.5 watts of power with response flat within 1 decibel from 20 to 20,000 cycles. Input is to be .015 volt r.m.s., and distortion negligible. Circuit may be that of Fig. 1.

The power amplifier selected is a 2A3, because it can deliver 3.5 watts without distortion. Specifications call for 250 volts on the plate, 45 volts cathode bias, and a 2,500-ohm load. Transconductance is 5,250 micromhos.

Manufacturers recommend that the peak a.f. signal on the grid of a class-A power amplifier equal the d.c. grid bias. Therefore we must supply a 45-volt signal to the 2A3 grid. A 45-volt signal on the grid of this tube develops 132 volts peak across a 2,500-ohm plate load resistor with a stage gain of 2.93. The peak voltage across the load is found from $E_{peak} = 1.414\sqrt{W \times Z}$, where W is output power and Z is load impedance. (The stage gain is equal to output voltage divided by input voltage.)

Our restriction to 1-db loss corresponds to a voltage ratio of 0.8913/1 or 89.13% and indicates that the signal at any point in the amplifier must be always within 89.13% of its value at mid-band.

Circuit constants

A 750-ohm cathode resistor will provide 45 volts of bias under recommended operating conditions. This resistor must be bypassed with a condenser with sufficiently low reactance to limit cathode degeneration so output voltage will not drop below 89.13% of 132, or 117.7 volts. At this level, the stage gain G is 2.6. Since gain with degeneration G is $\frac{G1}{1 + gmZk}$, when G1 is gain without degeneration, gm is transconductance in mhos and Zk is cathode impedance, we may transpose the equation to solve for Zk:

$$Zk = \frac{G1 - G}{G \times gm};$$

substituting,

$$Zk = \frac{2.93 - 2.6}{2.6 \times .00525}$$

$$Zk = 23.03 \text{ ohms.}$$

Since the impedance of the parallel combination is to be about 23 ohms, and the value of the resistor is 750 ohms, it is obvious that the parallel impedance will be roughly equal to the reactance of the condenser. We can therefore simply find the capacitance that has a reactance of 23 ohms at the low-frequency limit (20 cycles). The condenser should have a minimum capacitance of 257 μf.

This value may seem unreasonably large for a cathode condenser since it is seldom found in practice—even in video circuits—because other methods of low-frequency compensation are more commonly used.

A 500,000-ohm resistor is used in the grid circuit of the 2A3. This is the maximum permissible value according to tube manufacturers' specifications.

A voltage amplifier is needed to bring the input signal up to 45 volts peak. The 6SJ7 was selected from several tubes that will deliver this voltage because its high plate resistance and transconductance permit the use of a low plate coupling resistor and therefore its output is substantially level up to 20,000 cycles.

The high frequencies drop to 90% of mid-band level when shunting reactance (Xcs) is twice the equivalent resistance (Req) formed by plate, plate coupling, and grid resistors in parallel. Specifications permit the signal to drop to 89.13%. The 90% condition is within this limit, so we use its values to compute the value of the coupling resistor for the 6SJ7.

The shunting capacitance is the sum of the output capacitance of the 6SJ7, the input capacitance of the 2A3, and stray wiring capacitance. The output capacitance of the 6SJ7 is 7 μμf; the input capacitance of the 2A3 is Cgc + (G + 1) Cgp, where Cgc is grid-to-cathode capacitance (7.5 μμf), Cgp is grid-to-plate capacitance (16.5 μμf), and G is stage gain of the 2A3 (2.93 in this circuit). Assuming 10-μμf stray capacitance, the total shunting capacitance is 89.34 or 90 μμf. At 20,000 cycles, the reactance of 90 μμf is 88,495 ohms.

(Continued on page 56)

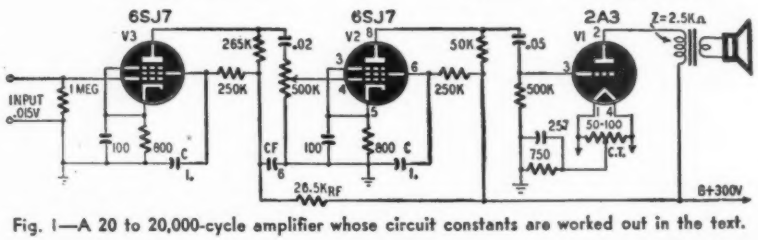


Fig. 1—A 20 to 20,000-cycle amplifier whose circuit constants are worked out in the text.

Push-Button Signal Generator

This European test oscillator circuit contains some ideas which have not been seen in American equipment

By ALFRED HAAS*

DESIGNED especially for outside servicing, this small 2-tube test oscillator is push-button operated, and the output is continuously variable in three steps. The frequency range is in four bands: 100 to 300 kc, 400 to 550 kc, 500 to 1600 kc, and from 6 to 18 mc.

The tubes are a 6K8 triode-hexode and a 12A7 diode-pentode. The diode section of the 12A7 serves as a half-wave rectifier for the B-plus voltage. The power transformer should be able to supply approximately 125 volts at 25 ma and 12.6 volts at 0.6 amp for the filaments. The heater of the 6K8 is connected across half the filament winding, or a 12K8 may be used and both tubes connected in parallel. Fig. 1 shows the circuit of the oscillator.

A 6-button d.p.d.t. push-button switch assembly is used for the band selector and control unit. The type of output is selected by pressing various button combinations as shown in Table I. Pressing No. 1 cuts off the audio, and pressing Nos. 1 and 6 together turns off the entire generator.

TABLE I

Output	Press
Modulated r.f.	2, 3, 4, or 5
Unmodulated r.f.	1 and 2, 3, 4, or 5
a.f.	6
off	1 and 6

The attenuator is a 500-ohm potentiometer and an L-network, providing three 40-db attenuation steps. The three taps are soldered to the output jacks which are insulated from the panel by ceramic washers. Since about 100 millivolts of r.f. is available, the outputs from the jacks are 10μv, 1 mv, and 100 mv. The a.f. output is about 5 volts, so the outputs from the jacks are 500 μv, 50 mv, and 5 v. The potentiometer permits continuous variation of output voltage in each range.

A neon bulb is connected across the filtered high-voltage supply to show the condition of the rectifier. It will start to glow about a half-minute after the generator is turned on. It is placed in a hole in the panel, so that no pilot lamp is necessary. A 50,000-ohm resistor in series with the neon bulb limits the current to a safe value. The 50-ma pilot bulb in the high-voltage lead acts as a fuse if the 12A7 rectifier current rises to much more than the maximum safe value of 30 ma.

The 6K8 is used as a plate-tuned oscillator, electron-coupled buffer amplifier, and mixer. The frequency is not affected by loading, and drift is negligible.

The pentode section of the 12A7 is connected as a Hartley-type audio oscillator with the screen grid tied to the plate. Inverse feedback provided by the unbypassed cathode resistor improves the wave form. The condenser across the primary of the audio transformer should be between .02 and .05 μf for a 400-cycle note.

The a.f. voltage applied to the grid of the 6K8 is adjusted by the voltage divider across the secondary of the audio transformer. Two resistors are used, one of 50,000-ohm resistance, and the other one adjusted till the voltage across the 50,000 ohms is about 3, checked with a vacuum-tube voltmeter. This gives 50-60% modulation. An ordinary a.c. rectifier-type voltmeter may be used to read the total voltage, and the resistors proportioned to give the proper voltage drop.

The audio wave form may be checked on an oscilloscope if one is available, or by a vacuum-tube voltmeter across the a.f. transformer secondary. As the value of the cathode resistor is increased, the a.f. output voltage will also increase until a further increase of resistance causes a decrease in output voltage. Beyond this point, the output has a good wave form. The value of the cathode resistor should be slightly greater than the one corresponding to the peak reading.

TABLE II, COIL DATA

Push	L1	L2
5	100-300 kc, 480 turns, No. 36 d.s.c.	26 turns, No. 36 d.s.c.
4	400-550 kc, 78 turns, No. 36 d.s.c.	6 turns, No. 36 d.s.c.
3	550-1600 kc, 62 turns, No. 36 d.s.c.	5 turns, No. 36 d.s.c.
2	6-18 mc, 8 turns, No. 22 enamel	3 turns, No. 32 d.s.c.

No chassis is used for the oscillator, and all parts are mounted on the panel (Fig. 2). The tubes are mounted on brackets made of 1/16-inch aluminum. The push-button assembly below the tuning condenser serves as a mounting base for the r.f. coils. This method insures extremely short leads between connections. The panel is made of ⅛-inch aluminum to give plenty of stiffness to the assembly, and the whole unit is enclosed in a metal cabinet for shielding.

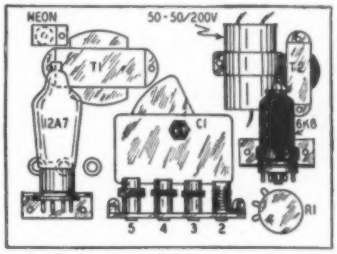


Fig. 2—Rear view, showing panel mounting.

The coils are wound on ½-inch forms with adjustable powdered-iron cores

(Continued on page 60)

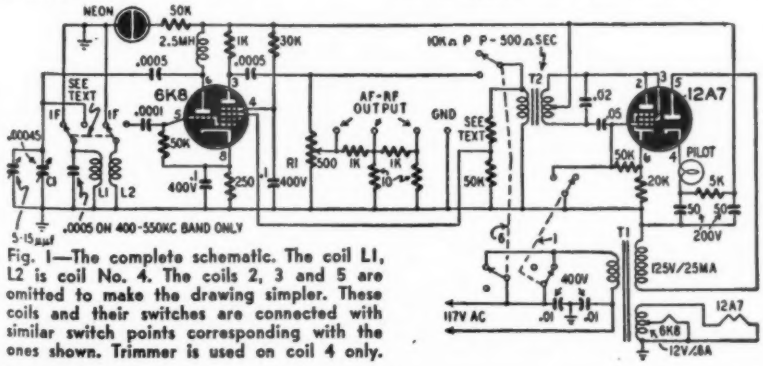


Fig. 1—The complete schematic. The coil L1, L2 is coil No. 4. The coils 2, 3 and 5 are omitted to make the drawing simpler. These coils and their switches are connected with similar switch points corresponding with the ones shown. Trimmer is used on coil 4 only.

* Consulting Engineer, Annecy, Haute Savoie, France.

Transatlantic News

By Major Ralph W. Hallows

RADIO-CRAFT EUROPEAN CORRESPONDENT

CURIOUSLY television is making little appeal so far to Jacques Dubois, the French equivalent of John Smith. There has been a regular television service in the Paris area for some little time, and not too bad a service either. Program times are: 1150-1205 (daily, except Saturdays and Sundays); 1600-1730 (daily, except Saturdays and every other Sunday); 2000-2130 (Tuesdays and Fridays). Times are GMT. Vision goes out on 46 mc with a peak carrier power of 30 kw, and sound on 42 mc with 5 kw behind it. Have any of you v.h.f. dx-ers picked up the audio part? I'd be rather surprised if you haven't, for v.h.f. is spanning enormous distances just now—a point to which I'll return later. The vision system is 455 lines per frame and 25 frames per second, so it will not suit American standard televisers. Either 25 frames per second or 50 frames interlaced are likely to be the standards of European countries for the frequency of their a.c. main supply is 50 cycles per second.

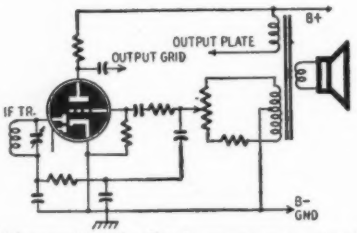
I don't know of any ready-for-service French televiser on the market. Certainly I have not seen one advertised in any French radio magazine. One sees a few kits of parts advertised, and there's an occasional article on how to build a televiser. But that's just about all. I believe that a few cathode-ray tubes with bigger screens than 2 to 4 inches are produced in France. The cost of the larger ones is prohibitively high. That may well be the reason why there are so few viewers of the programs of Télévision Française, the concern responsible for the present service.

Two novel circuits

Some of the new developments in broadcast receivers are a bit hard to evaluate. The technical value of some of them may be secondary to their advertising value. However, some of these "talking points" have real interest to the radioman.

The Bush *Bifocal Listening* is a variation of our old friend the local-distant switch. An arrangement for changing the i.f. bandwidth from 8-9 kc (distant stations) to about 12 kc (local) is linked to the volume control. On a loud local transmission the volume control is turned down and the greater bandwidth comes in. The phrase "bifocal listening" was coined by Christopher Stone: "Just as my bifocal glasses enable me to see clearly at long or short distances, so my Bifocal radio gives me good listening on near or distant stations."

The Kolster-Brandes "bridge positive-negative feedback" links the feedback control and the volume control—rather, makes them one and the same thing. The output transformer is said to have a third winding, tapped and grounded at its center and connected across the volume control, as shown in the sketch.



Bridge-positive feedback, approximate circuit.

Audio voltages from the transformer aid or buck those from the diode, according to the position of the control. When it is on dead center, there is no feedback. By moving it in either direction, positive or negative feedback may be applied. I can't, I'm afraid, give constants, as none have as yet been published and firms are, as a rule, rather sticky about releasing them. But the circuit doesn't look as if any values would be very critical. Experimenters may find it interesting.

The drawback is, of course, that as the sensitivity is increased on distant stations, distortion is automatically made worse. However, where great volume is required, as for dancing, extreme quality is not demanded, and where plenty of negative feedback is applied for high fidelity, the volume needed is as a rule not great.

And in Russia

The Russians are taking television very seriously. The technical development and the program services are, of course, both official matters there; so there can't be much doubt that television will be popular. If the authorities decide that television is good for the soul of Ivan Ivanovitch, he'll have to be keen on it, whether he likes it or not! An article in the Soviet magazine *Radio* gives an account of the expansion contemplated between now and 1950. In addition to the stations which have been working for some time in Leningrad and Moscow, new transmitters of moderately high power are to come into action at Kiev and Sverdbovsk. But that is a long way from being all. Assuming that a field-strength of 1 millivolt per meter is required for good reception, it's calculated that the following service areas are obtainable from small transmitters with antenna systems 50-60 meters in height.

Transmitter output (watts)	Radius of service area (miles)
80	5
200	6.25
500	7.8
800	8.4
2,000	10.3

It must be remembered that in most parts of the U.S.S.R. there is comparatively little man-made static to cause interference with v.h.f. transmissions.

Now, here comes a very interesting idea. It is suggested, not only that transmitters rated up to 1,000 watts can be made from standard components by amateurs, but that they *should* be made all over the country. These stations (which can use air-cooled transmitting tubes) won't be owned or used privately. They'll be built and brought into action, in small towns, by the cooperative effort of local fans and will then be handed over to the municipal authorities to supply the television entertainment of the townsfolk.

That strikes me as a magnificent idea for getting a nation-wide television service going in the quickest possible time in a vast country which contains innumerable small towns and villages. The big snag seems to be not the technical, but the entertainment side. There's no provision for long-distance hookups; hence the programs must, presumably, be of local origin. My own feeling is that I'd pay quite a bit to be spared nightly entertainments by *my* local citizenry!

Long-range V.H.F.

I often think that the writers of radio textbooks published twenty or more years ago must feel like taking running jumps into the nearest and deepest lake when they re-read some of the statements that they once made in cold, hard print. You'll find it was stated in the 1920's that frequencies above 3 megacycles were unlikely ever to be of any great value for long-distance communications. More recent writers state categorically that the range of transmissions on frequencies above 30 mc cannot be much beyond the visual horizon. It has, in fact, often been declared that with v.h.f. transmissions there is no usable ground wave and no usable sky wave, the only serviceable kind of propagation being the direct wave.

Things move so rapidly in radio today that you hardly know where you are sometimes. If ever I write another radio

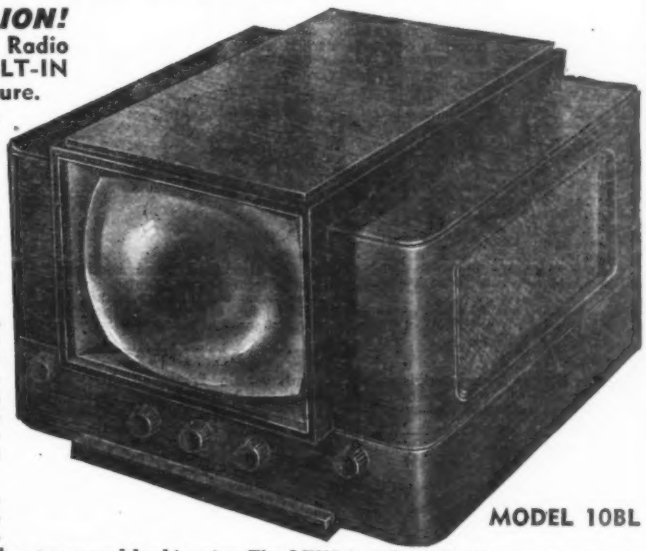
(Continued on page 70)

A GREAT TRANSVISION FIRST!

NEW. . . Sensational TRANSVISION Development now offers LARGE-IMAGE DIRECT-VIEW TELEVISION at low cost!

BIGGEST VALUE in TELEVISION!

Model 10BL TELEVISION KIT with FM Radio . . . Features Beautiful CABINET with BUILT-IN LENS . . . Gives LARGE 120 Sq. In. Picture.



MODEL 10BL

Roto-picture effect: Picture "rotates", giving the appearance of being in focus and clearly visible from every angle! Uses 10″ Electromagnetic Direct-view Picture Tube.

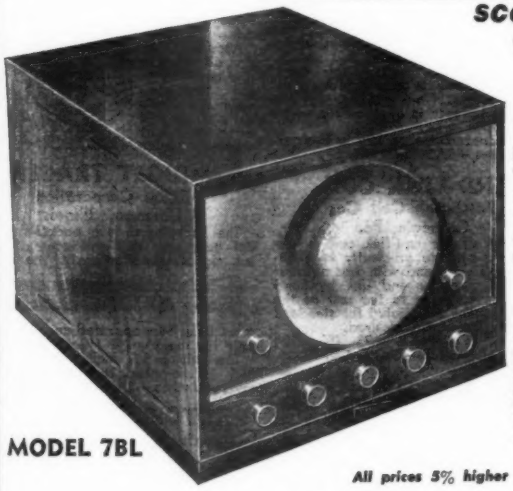
Features new-type cabinet with built-in lens which magnifies, clarifies and heightens contrast of the picture. The lens also creates the effect of apparent rotation of the picture, so that when the observer moves, the picture still seems to be in focus and clearly visible from any angle.

ECONOMICAL KIT, EASY TO ASSEMBLE. In point of value, this Television Kit provides the opportunity of acquiring a LARGE-IMAGE direct-view television set at a *VERY LOW PRICE*; also very economical from a tube replacement angle. This model is available in *KIT FORM*, for easy assembly; no technical knowledge required. Simple step-by-step instructions are included. *Saves as much as 50% over the cost of receivers with similar picture magnitude.*

TECHNICAL DATA: Model 10BL uses a 10″ Electro-magnetic Direct-view Picture Tube; has complete F.M. Radio which comes completely factory-wired; receives all channels in any area; supplied complete with antenna and lead-in wire. The LENS is 15″ x 11″, giving a picture size of approx. 10″ x 12″ or 120 sq. in.; the highly-styled cabinet measures 26″ wide x 17″ high x 19″ deep, available in Mahogany, Walnut or Blonde finishes.

PRICES: Transvision *MODEL 10BL Television Kit*, with FM, 10″ tube, cabinet with built-in lens, antenna, 60 ft. lead-in wire ..... **List $359.00**

MODEL 12BL, same as 10BL except that it uses 12″ tube, giving picture area of 130 sq. in. ..... **List $389.00**



MODEL 7BL

SCOOP! **New revolutionary MODEL 7BL Television Kit with specially designed CABINET with BUILT-IN LENS.**

- Uses 7″ Electrostatic Picture Tube
- Gives 50 square inch picture of superior quality

FEATURES: Though it has a 7″ tube, the effect is equivalent to a 10″ set because the built-in lens magnifies the picture. Also picture performance is superior because the lens clarifies and heightens contrast of the image. Picture "rotates" apparently, as the observer moves, giving the effect of always facing the observer. This is effective to a very wide angle. Pre-tuned for 5 channels.

PRICE: including cabinet with built-in lens, antenna, 60 ft. of lead-in wire ..... **Net $189.00**

TRANSVISION "SERVICE NOTES"

The Key to Successful Television Servicing

Transvision's "Service Notes" is a compilation of confidential Television Notes and Information, the product of experience with over 20,000 television receivers, now made available to the public. The "Service Notes" is a most valuable compilation of instructions and data on Magnetic and Electrostatic Television Receivers. Though compiled in the course of servicing Transvision Kits, the information is applicable to any type of television receiver.

"SERVICE NOTES" is complete with photographs and diagrams. The information is worth a small fortune. The cost is low. LIST $2.95

All prices 5% higher west of Mississippi; all prices fair traded.

For further information see your distributor, or write to:

TRANSVISION INC., Dept. RC, NEW ROCHELLE, N.Y.

See TRANSVISION at the PARTS SHOW: There will be a *SPECIAL TRANSVISION EXHIBIT from May 10th through the 14th* at the *SHERMAN HOTEL* (Chicago) in the *GOVERNOR'S SUITE!* Be sure to see the interesting new Transvision Developments in Television and F.M.

NEW RADIO·ELECTRONIC DEVICES

TV BEAM-BENDER

Clarostat Manufacturing Co.
Brooklyn, N. Y.

The Beam-Bender is used with television cathode-ray tubes that require an external means of controlling loose ions. This permanent-magnet type is entirely self-contained and can be attached without tools, which also means elimination of the breakage hazard.

The unit consists of two ring magnets held in a nonmagnetic mounting collar. The magnets provide magnetic flux proportional to the required beam-bending function in the tube. The forward magnet, indicated by the arrow stamped on the mounting collar, is adjustable.

The assembly is slipped over the base of the tube and onto the right position on the neck. Three spring fingers provide an adjustable frictional fit.

Since there is no rubber or organic material in this assembly, there is no danger of the mounting adhering to the glass neck of the tube.—RADIO-CRAFT

MODERNIZATION UNIT

Radio City Products
New York, N. Y.

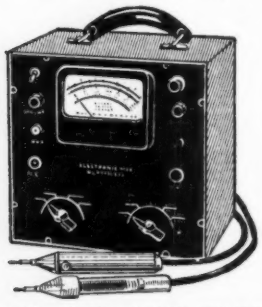
The models 120 and 125 are complete modernization units, designed to bring up-to-date many tube testers that have become obsolete.

Each of these units has a flexible cable with a plug that is inserted into the loctal socket of the old tube tester. The new tubes are then tested in the sockets provided in the units. Sockets are included for the new miniature and subminiature tubes. Extra blank sockets and spaces are provided for additional new sockets, should new types of tube bases be brought out in the future. Tube-testing charts and data are supplied with the unit.—RADIO-CRAFT

V.T. VOLT-OHMMETER

Electronic Manufacturing Co.
Harrisburg, Pa.

The Model 110 vacuum-tube volt-ohmmeter is designed for servicing television receivers. The d.c. ranges are



0-3, 30, 150, 300, 600, 3,000, and 15,000 volts. On a.c. the ranges are 0-3, 30, 150, and 300 volts. The a.c. range is accurate up to 300 mc.

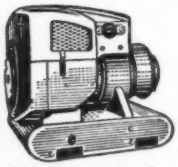
The entire unit is fungus-proofed to maintain stability over a long period of time.—RADIO-CRAFT

A.C. POWER PLANT

D. W. Onan & Sons, Inc.
Minneapolis, Minn.

A 3,500-watt, 50-60 cycle a.c. electric plant weighing approximately 54 pounds per kilowatt as Model 3CK-1R is one of a group employing the Onan "CK" air-cooled, 4-cycle, 2-cylinder gasoline engine as a prime mover.

The 3CK-1R has electric push-button starting, in the form of a special winding on the plant's generator which serves as the cranking motor during the starting cycle. A 12-volt automotive-type battery furnishes the starting power.



The air-cooled engine has a removable cast-aluminum engine hood to protect it from dust and water.

The new plants will produce about one-kilowatt hour of electricity per quart of gasoline.—RADIO-CRAFT

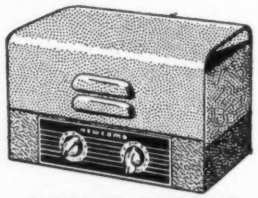
AUDIO AMPLIFIER

Newcomb Audio Products Co.
Hollywood, California

The Model E-10 amplifier uses push-pull 6V6 tubes in a multistage inverse feedback circuit. Power output is 10 watts at less than 5% distortion. The frequency response is from 50 to 10,000 cycles within 2 db.

Two inputs are provided: 2 megohms for a microphone, and ½ megohm for a phono pickup. The tone control is of the treble-attenuation type.

The unit consumes 60 watts and weighs 10½ pounds. Its over-all dimensions are 5¾ x 10⅜ x 6¾ inches.—RADIO-CRAFT



WELDED CHASSIS

E. F. Johnson Mfg. Co.
Waseca, Minn.

The new line of E. F. Johnson chassis have no overlaps at the corners. This new feature permits the locating of holes all the way to the corners. Volume controls, toggle switches, etc., can be mounted flush inside the chassis because of the single thickness feature. Rigidity and durability are assured by welded tie bars on the inside of the turned under bottom edge where they do not interfere with the mounting of components. Bottom plates may be fastened to the reinforced edges.—RADIO-CRAFT

STEP-DOWN TRANSFORMERS

Standard Electrical Products Co.
Dayton, Ohio

Staco step-down transformers permit operation of standard 115-volt, 50-60 cycle radios and other equipment from a 200-240-volt supply.

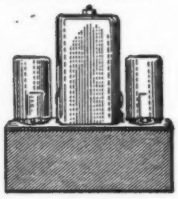
The transformers are built of high-quality silicon steel for cool operation. Coils are layer-wound and varnish-impregnated. Each is tested at ten times its rated voltage and at three times the operating frequency.

The units are supplied with a 6-foot line cord and plug and a receptacle. Various sizes are available from 75 to 2000 watts.—RADIO-CRAFT

FM ADAPTER

Schuh's Radio Parts
Chicago, Illinois

This new FM adapter can be installed on any AM receiver to adapt it to narrow-band FM reception.



The unit is available in two models, 455 to 465 kc and 915 kc for use with BC-348 surplus receivers. The two tubes are a 6AK5 limiter and 6AL5 discriminator.—RADIO-CRAFT

TAPE RECORDER

Amplifier Corporation of America
New York, N. Y.

Model TP-800-C is one of a new series of portable tape recorders. It will record and play back frequencies up to 12,500 cycles, with less than 3% distortion. In addition, it contains an instantaneous start-stop clutch.

This model, and others in this series, can be adapted to automobile operation by means of a 6-volt d.c. inverter. They can operate in any position—even upside down.

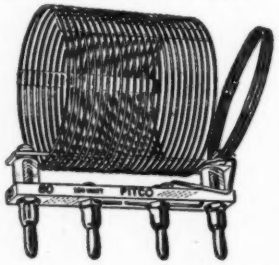
The recorders are packed in two carrying cases.—RADIO-CRAFT

END-LINK COIL

Pittsburgh Coil Co.
Carnegie, Pa.

This adjustable end-link coil is designed to operate efficiently in a variety of circuits and with beam-power tubes. Moving the end link by hand varies the coupling to the rest of the coil. It can be substituted for standard fixed end-link coils if desired.

This coil is available in 75-, 150-, 250-, and 500-watt sizes.—RADIO-CRAFT



CONTACT MICROPHONE

Electro-Voice, Inc.
Buchanan, Mich.

Contact microphone Model 805 is designed for stringed instruments.

Frequency response of the pickup is 40 to 8,000 cycles. The output level is from 0.1 to 1 volt, depending upon the type of instrument. An inertia-type crystal, sealed against moisture and acoustic feed-back, is the generating element of the unit.

The microphone is 2¼ x 1 x 7¾ inches and weighs 2 ounces. It comes complete with a clip for attaching it to the instrument, and a 15-foot shielded cloth-covered cable.—RADIO-CRAFT

H.V. POWER SUPPLIES

Condenser Products Co.
Chicago, Illinois

The HiVolt PS-1 and PS-2 are hermetically sealed low-current power supplies for transforming 117 volts a.c. to 2,400 volts d.c. The PS-1 is designed to charge capacitors for use in electronic photoflash equipment. The PS-2 is intended for use in oscilloscopes and television receivers.

The supplies measure 3¾ x 3 3/16 x 5½ inches and weigh 2¼ pounds. Humidity has no effect on the components.—RADIO-CRAFT

V. T. VOLTMETER

Electronic Instrument Co.
Brooklyn, N. Y.

The Eico Model 221 is a wide-range completely electronic vacuum-tube voltmeter and ohmmeter.

The a.c. and d.c. ranges are 0.5, 0-10, 0-100, 0-500, and 0-1,000 volts. The ohmmeter measures from 0.2 ohm to 1,000 megohms in five ranges. A wide-range decibel scale is included.

Accuracy is 2% on all ranges, and stability is such that zero drift is practically eliminated after a short warm-up period.—RADIO-CRAFT

MIDGET TRACER

Radex Corporation
Chicago, Illinois

The Pocketracer is a pocket-size signal generator that produces r.f. and a.f. signals simultaneously. The instrument is battery-operated and consumes only 150 ma from a 1½-volt battery.

The unit is 5¼ inches long and ⅝ inch in diameter. The signal range is several inches.—RADIO-CRAFT

PHOTOELECTRIC CELL

American Scientific Company
New York, N. Y.

The Iris is a self-generating barrier-layer photoelectric cell capable of several hundred microamperes output, depending upon the intensity of the light.

It is a compact unit, firmly mounted on a piece of transparent plastic and is approximately 1½ inches square. Two holes are provided for mounting.—RADIO-CRAFT

McMurdo SILVER Announces the NEW 900A VOMAX

Net Price $68.50

CONTINUOUS RESEARCH, study of thousands of cases of actual field experience now enable us to offer you the new 900A "VOMAX". Revolutionary as was the original, the new 900A forges far ahead in simplicity, dependability all-around *usability*.

Just 34 months ago McMurdo Silver Co. announced "VOMAX"—the first truly stable, ultra-high input resistance v.t.v.m. Lifting the v.t.v.m. out of the limited laboratory-application class, Silver engineering and use-experience made "VOMAX" the first *universal* v.t.v.m. Its acceptance was instant and overwhelming — for "VOMAX" will measure, at input resistance so astronomically high as not to "load down" any circuit to which it may be connected — d.c. volts, a.c., a.f., i.f. and r.f. volts, d.c. milliamperes and amperes, resistance and db. — all over tremendous range and with laboratory accuracy. Used in scores and hundreds by such competent organizations as the National Bureau of Standards, the Navy, Army, F.C.C., C.A.A., Veterans Administration, G. E., Western Electric Co. Recommended by Bendix, "VOMAX" is consistently copied, never equalled — stands today as "standard of comparison" for the entire industry.

In announcing the new "VOMAX" we think you'll agree that we can feel just a bit proud of having again done the impossible to give you the world's finest *universal* Laboratory Caliber Electronic Test meter at only Net $68.50.

FEATURES

- Non-breakable glass 7" meter completely protected behind panel.
- Single hand-convenient probe gets into tight places, banishes usual snarl of easily lost and broken test leads.
- Newer — and fewer — minature u.h.f. tubes.
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? WIND INDICATOR

Please print a diagram of an electronic wind velocity and direction indicator.—W.R.H., Newport, R. I.

A. Fig. 1 is the diagram requested. The contact interrupter wheel, in the velocity indicating circuit, is a small gear or commutator mounted on the shaft of an anemometer. Its purpose is to break the connections between the 6V6 grid and ground from 10 to 20 times per revolution of the shaft. One break per revolution will suffice if larger condensers and resistors are used in the range switch circuit.

Two velocity ranges are provided. One is for winds of low velocity and the other for strong winds. The sensitivity control and the 100,000-ohm range resistors should be adjusted for best results.

The wind direction indicator is designed around the Ohmite RB-2 direction-indicating potentiometer. Its shaft may be directly coupled to the shaft to the vane or a 1:1 link may be used.

The 1,250-ohm resistor in the high-voltage lead should be adjusted so the voltage regulator tubes draw 40 ma with the 6V6 out of its socket.

? SMALL PA AMPLIFIER

I would like to have a diagram of a small 3-tube PA amplifier with input channel for a radio tuner or phono pick-up and a separate channel for a crystal mike.—L.T., New York, N. Y.

A. This small amplifier (Fig. 3) delivers about 0.8 watt and gives good results when used with an 8- or 10-inch PM speaker. The low-gain channel will work with a radio tuner or a high-output phono pickup. The high-gain channel can be used with most crystal mikes.

? FENCE CHARGER

I would like a diagram of an electronic fence charger to operate from 117-volt a.c. lines. Please include pulse rate and voltage controls.—J.Y.R., Bethlehem, Penna.

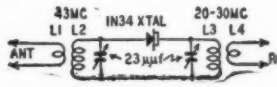
A. This fence controller (Fig. 2) has variable output and variable pulse rate. C1 and R2 control the output voltage. If C1 is made up of a number of small condensers which may be connected in parallel through a switch, a wider voltage variation is possible. R1 sets the pulse rate. This should be adjusted to produce about 1 pulse per minute.

T1 is a special fence controller transformer with a 200-volt primary and a secondary delivering an instantaneous voltage peak of 3,000 volts into an open circuit. This unit may be a Stancor type P-6126 or equivalent.

? TUBELESS CONVERTER

I have an all-wave receiver tuning down to 30 mc and would like to increase its range to about 43 mc by using a tubeless converter like the one described on page 19 of the February 1947 issue of Radio-Craft. Can you supply the necessary coil data?—A.T.S., Cleveland, Ohio.

A. L2 consists of 11 turns of No. 10 enameled wire air-wound with an inside diameter of 7/16 inch. The coil should



be about 1½ inches long. L1 consists of 2 turns No. 18 d.c.c. wire interwound with L2. L3 has 24 turns of No. 18 d.c.c. wire air-wound on a 7/16-inch form and spaced to about 1½ inches. L4 is 3 turns of No. 18 d.c.c. interwound with or closely coupled to the low end of L3. L1 and L4 may be adjusted for best performance with a particular antenna and receiver. The length of L2 and L3 may be varied to alter the tuning range.

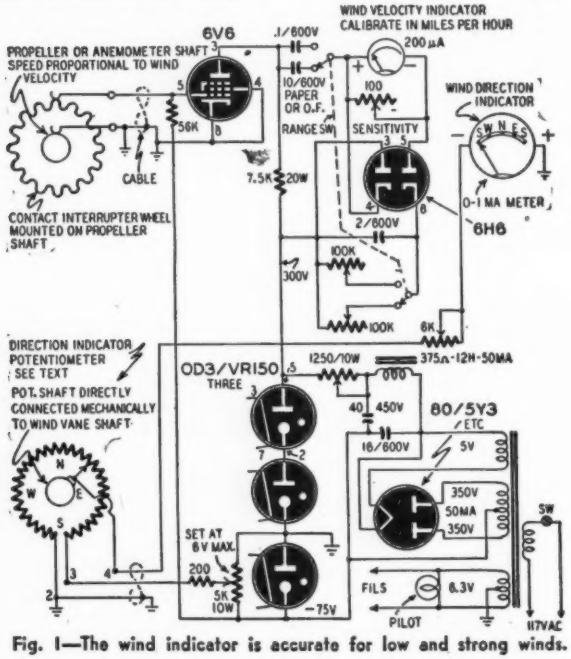


Fig. 1—The wind indicator is accurate for low and strong winds.

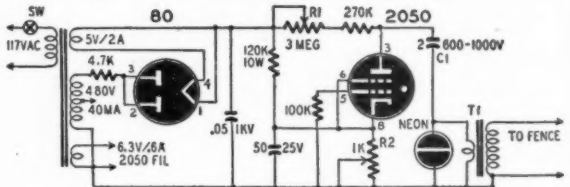


Fig. 2—This electronic fence charger delivers about 3,000 volts.

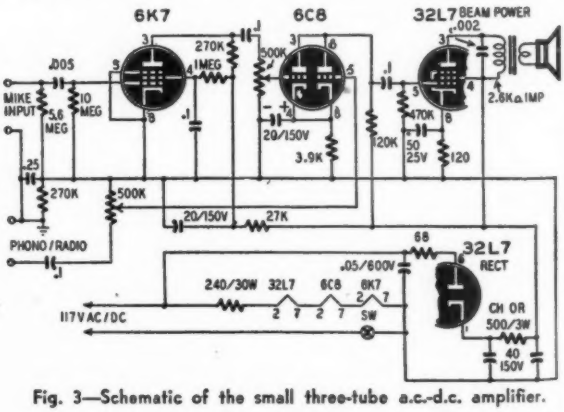


Fig. 3—Schematic of the small three-tube a.c.-d.c. amplifier.

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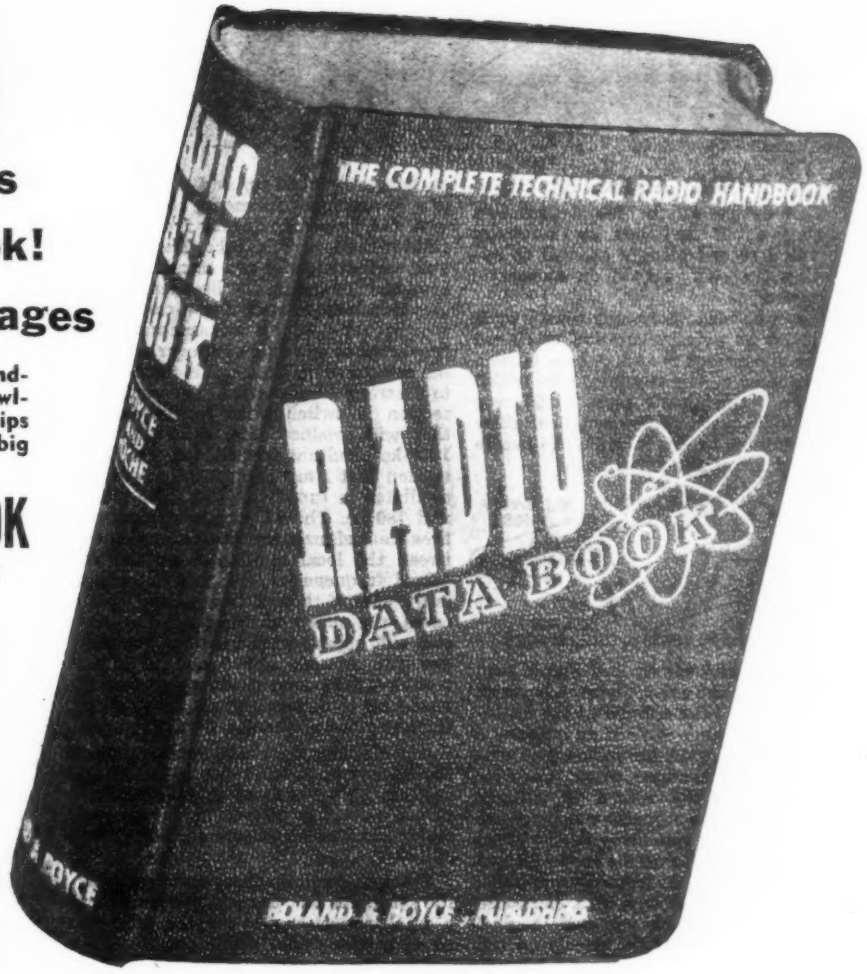

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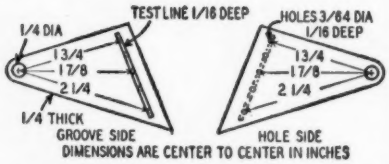
RADIO·ELECTRONIC CIRCUITS

PHONO ADJUSTER

This device will be found useful in setting cutoff switches on manually operated record players as well as adjusting the change-cycle on automatic changers.

It can be made from any plastic such as lucite or polystyrene and machined to the dimensions shown. A hole ¼ inch in diameter or slightly larger is drilled to permit the plastic piece to fit over the spindle just loosely enough to allow the turntable to rotate while the needle rests in one of the small holes.



The side with the scribed line is used to determine the exact distance between the needle and the spindle at the beginning of the change cycle of an automatic changer. It is used for making adjustments on the changer when the cycle begins before the record is entirely played. For these adjustments, place the device over the spindle with the lined side up and set the needle in the line at the point furthest from the spindle. Move the device slowly in a clockwise direction until the change cycle begins. Note the position of the needle on the scale and adjust the changer accordingly.

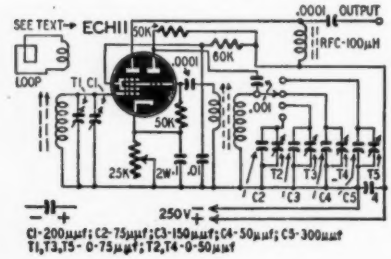
The other side, which has several shallow holes, is used for setting motor cutoff switches on manual players. Place the needle in the hole the desired distance from the center and adjust the switch to cut off at this distance. For this adjustment, the device is a great help in keeping the tone arm at an exact distance while the switch is being adjusted.

C. N. CARTER,
Nanaimo, B. C., Canada

HETERODYNE SIG GEN

Convenient to carry on outside service calls, this signal generator gives good results. My circuit uses an ECH11 but American equivalents such as a 6J8 or 6K8 may be used.

The signals from a local broadcast station are picked up and converted to any convenient frequency by mixing with the proper frequency from the oscillator section of the tube. The antenna and oscillator coils are standard units designed for use on the broadcast band. The loop may be wound to a convenient size or replaced by an antenna hank connected to one side of the primary of the antenna coil. This coil is fixed-tuned to a strong local station. The oscillator section is switch-tuned to frequencies that will produce 456-, 465-, 600- and 1600-kc resultant frequencies. The local station that I use is on 820 kc, and the oscillator is tuned to 1276, 1285, 1420, and 780 kc. The i.f. and low-frequency broadcast signals are the difference between the local oscillator and the received frequencies. The 1600-kc output is the sum of these 2 frequencies. In all cases, the sum and difference frequencies will appear in the output, but they are far enough apart not to cause trouble. (The sum frequencies can be used also to deliver signals that fall in the lower end of the short-wave bands.)



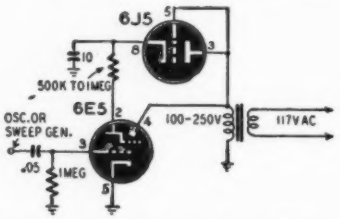
The signal output is controlled with a 25,000-ohm control in the cathode circuit. A high order of stability is obtained by using ceramic fixed and variable condensers in the oscillator circuit.

Operating voltages may be taken from the set under test in many instances, or a small power supply may be incorporated in the signal generator.

HARDY MEYER,
Bucharest, Roumania

SIG GEN CALIBRATOR

I use this simple circuit for calibrating sweep-generators and a.f. oscillators. It uses a magic-eye indicator tube which, in this case, does the work of a cathode-ray tube but has the advantage of small size and needs no high-voltage supply.



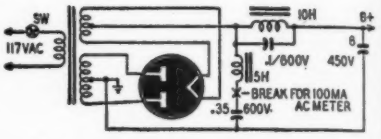
The oscillator to be calibrated is connected to the control grid of the indicator tube, and a.c. is applied to the target. The target is illuminated for only the positive half-cycles, and a time base is established for calibration. At points where the oscillator frequency is some harmonic of the line frequency, the shadow on the target remains motionless. At frequencies other than harmonics, the shadow flutters.

The range of the calibrator can be increased by using different frequency sources for the time base. However, the 60-cycle line or some multiple of it is convenient—it can be depended on to be exactly correct.

OTTO VON GERICKE,
Wiesen, Switzerland

TUNED RECTIFIER FILTER

The filter circuit of this power supply uses condensers and chokes connected to form series-resonant and parallel-resonant wave traps. These traps are tuned to twice the frequency of the line voltage.



The current rating of the choke in the parallel-resonant trap is equal to the current drawn from the supply. The choke in the series-resonant trap has a rating equal to the amount of a.c. flowing through the condenser. This current can be measured with an a.c. milliammeter.

When a tuned filter is used, less inductance and capacitance is needed, and the filtering is better.

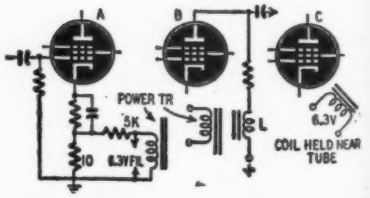
EVERETT D. THOMAS,
Morganton, N. C.

HUM SUPPRESSION

There are several effective, but not too well-known, methods for suppressing hum. They consist of injecting a voltage 180 degrees out of phase to the hum voltage into the circuit. At A in the figure, some voltage from the power transformer is fed to the grid of one of the tubes, (usually in the preamplifier). If the hum increases, the tap on the winding is reversed. The value of the 5,000-ohm resistor can be increased or decreased for fine adjustment.

In B, a small coil of about 100 turns wound on a ½-inch core is placed in either the plate, grid, or cathode circuit. The coil is then held near the power transformer and rotated till the hum diminishes. For tubes with heavy filament currents, the circuit at C is used. The coil is the same as in B, but with about 500 turns. It is important that the core should not touch the metal shell of the tube.

A. A. BOSCHART,
Delft, Holland



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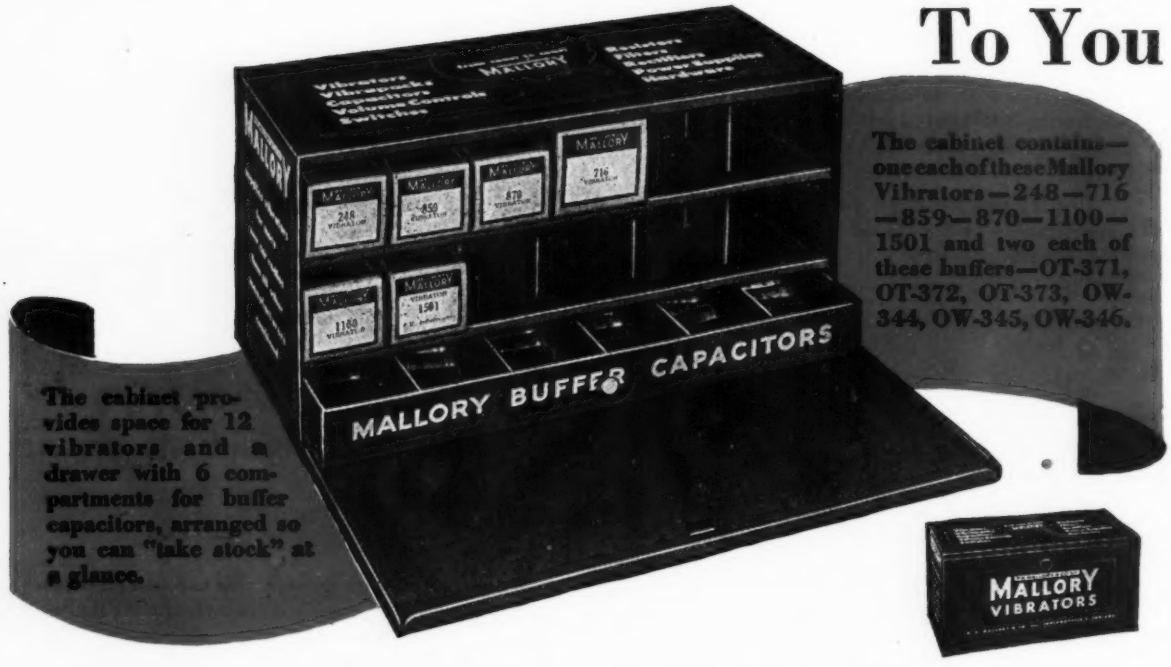

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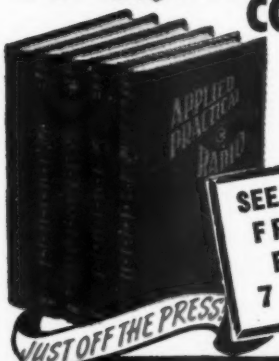

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Technotes

. . . . PHILCO AUTO RADIOS

If the new models suddenly go dead, take a look at the i.f. transformers. Midget i.f. transformers are used in the models CR-4 and CR-6. There is very little clearance between the lugs and the can. If great care is not used when soldering leads to the lugs, solder will run down the lug and short to the can. On several sets I have found the plate or B-plus lugs shorted to the chassis.

HAROLD L. BLISS,
Francesville, Ind.

. . . . OSCILLATOR FAILURE

Some sets play perfectly in the shop yet suffer oscillator failure when the set is returned to the owner's home. To prevent this, I have a Variac and a.c. voltmeter in the line and lower the operating voltage on the set until the oscillator fails. If the set is a 3-way portable or a.c.-d.c. model, the oscillator will probably cut out between 80 and 90 volts input. If it cuts out above 90 volts, with normal B-voltages, try replacing the oscillator tube. If this does not cure the trouble, check the components in the oscillator circuit.

JOHN B. MOORE,
Lebanon, Tenn.

. . . . GROUNDING A.C.-D.C. EQUIPMENT

A.c.-d.c. apparatus may be operated safely when attached to ground if *only one wire* is plugged into the line. A good ground is attached to the equipment and *only one terminal of the line cord* attached to the plug. (If the line cord is of the resistor type, the terminal with the resistor must be the one attached.) The plug is then inserted in the socket. If it is plugged in correctly, the equipment will operate. If the connection is wrong, no damage will be done, and the tubes will simply fail to light.

It is sometimes convenient to attach equipment to earth, and at other times there is danger of accidental grounding. This kink is useful in either case.

ERIC LESLIE,
New York, N. Y.

(This circuit will not work if the equipment has a negative return isolated from the chassis.—*Editor)*

. . . . ECHOPHONE EC-1 AND EC-1A

If the pilot lamp burns brightly and then burns out, look for a shorted by-pass condenser at the plate of the 35L6. Replacement with a 600-volt unit prevents future breakdowns of this sort.

RICHARD LYTWYN,
Detroit, Mich.

. . . . INTERMITTENT COILS

Automobile sets and others sometimes develop intermittent noise from corrosion in the i.f., oscillator and r.f. coils caused by dampness. If the coils are in a plate circuit, shorting the plate to ground through a 2,500-ohm resistor will draw enough current through the coil to open it permanently.

B. BUEHRLE, JR.
Ferguson, Mo.

. . . . BATTERY RADIOS

When the complaint is distortion in the audio section of farm or portable radios with 1.4-volt tubes, replace the output tube.

This should be tried even when the tube and all components check good. This trouble is very common in sets with 3Q5's.

JOHN MEDNANSKY,
Belle Fourche, S. D.

. . . . FIRESTONE 4—A—30

If the complaint is very poor volume, look for an open screen resistor to the 6SJ7 first audio tube. Poor volume with serious distortion is often caused by the 6K6 cathode resistor changing in value. Replace with a 450-ohm, 10-watt, wire-wound unit. Reception with push-button tuning only may be due to a shorted .01-μf condenser from the screen of the 6SA7 to ground. Replace with a 600-volt condenser to prevent future trouble.

If the dial turns hard, look for misalignment in the guide pulley on the side of the chassis. Bending it back into alignment will remove the stiffness.

JOHN R. SIMPSON,
Gainesville, Fla.

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FRONT PANEL CONTROLS

- A — Sweep width 500 KC to approx. 10 MC
- B — Phasing control
- C — Tuning vernier control 10 to 1 ratio
- D — Selecto switch FM — RF — CAL
- E — RF Output control
- F — 60 cycle horizontal sweep output
- G — Amphenol RF output shielded connector

FREQUENCY RANGE 3 BANDS
(No band switching necessary)
(2 to 227 Megacycles)

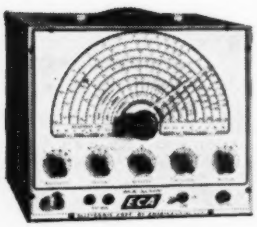
- A — 2 — 77 MC
- B — 40 — 154 MC
- C — 151 — 227 MC
- D — Calibration and reference scales
- E — Dial scale length

TUBE LINEUP

- A — 6C4 — Fixed frequency modulated oscillator
- B — 6C4 — Continuously Variable beat frequency oscillator
- C — 6C4 — Mixer — Cathode follower output tube
- D — 5Y3 — Rectifier tube

GENERAL INFORMATION

- A — High frequency insulation throughout
- B — Maximum output 500,000 U/V
- C — Power required 105-125 Volt 50-60 AC 35 Watts
- D — Power line filter built in
- E — Special Midline capacity tuning condenser
- F — Pilot light line indicator
- G — Generator output can be used either frequency modulated or pure RF



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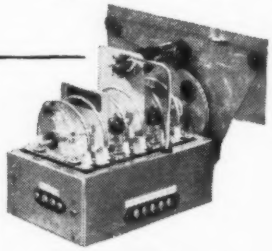

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For use with 10.7 MC I.F.S., high Q resonant tuned lines. Heavy silver overlay on lines and contacters. High frequency insulation throughout I-RF stage, detector, and oscillator. Large 7" sliderule dial. Chassis floated, non-microphonic. **$15.95**

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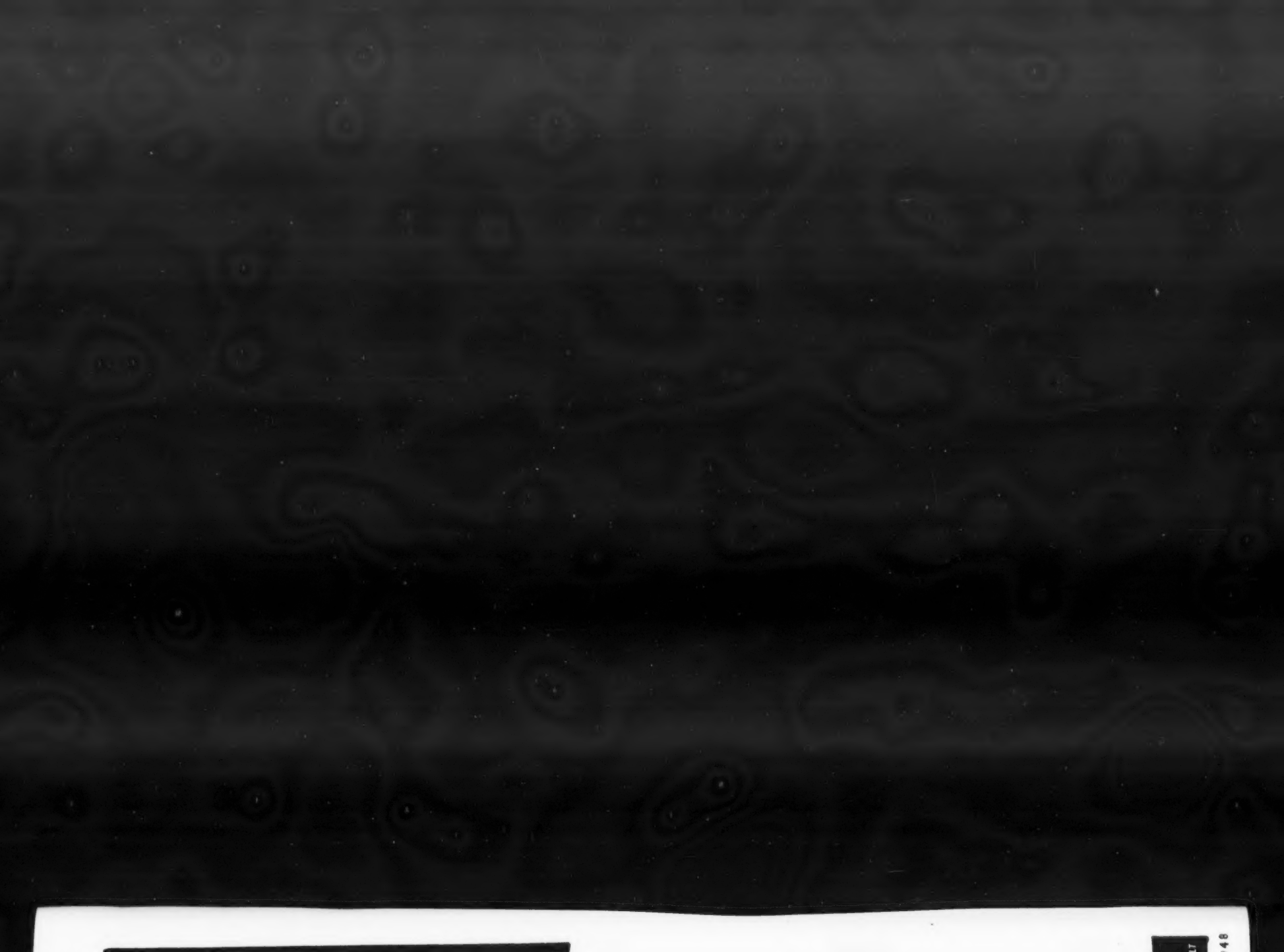

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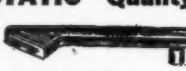

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★ STURDY STEEL CASE
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RANGES—
DC Voltmeter—0-5-50-250-500 volts
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METER
3½" round bakelite case. Sturdy D'Arsonval movement.

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Interstage, types available immediately at real savings.
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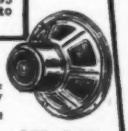

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Size	Wt. (oz.)	Price
3"	1	$1.40
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0-1 D.C. milliameter 3½" round bakelite case. The latest in meter design. Pine Foundation Unit. Hundreds of uses for this instrument. Complete with mounting hardware.
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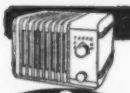

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Cat. No.	Cap. Mfd.	500 Lots 400V	100 Lots	Single Lots
27-837	.001	25.65	5.40	.06
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27-839	.005	25.65	5.40	.06
27-840	.01	25.65	5.40	.06
27-841	.02	25.65	5.40	.07
27-842	.025	29.93	6.30	.07
27-843	.05	29.93	7.20	.08
27-844	.1	34.20	8.10	.09
27-845	.2	38.48		
		600V	6.30	.07
27-846	.002	29.93	6.30	.07
27-847	.0025	29.93	6.30	.07
27-848	.005	29.93	6.30	.07
27-849	.01	29.93	6.30	.07
27-850	.02	700V		
27-851	.0035	29.93	6.30	.07
27-852	.005	29.93	6.30	.07
27-853	.02	29.93		
		1000V		
27-854	.0025	34.20	7.20	.09
27-855	.0035	34.20	7.20	.08
27-856	.005	34.20	7.20	.08
27-857	.01	34.20		
		1200V		
27-858	.005	34.20	7.20	.08
		1400V		
27-859	.0025	39.43	9.10	.09
		1500V		
27-860	.0015	39.43	9.10	.09

On quantities of 100 or over condensers may be assorted in Lots of 25 to obtain maximum discount.

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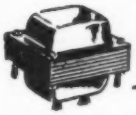
Many uses for OSC and buffers, small XMTRS. New shielded transformers operates 274 Xmtr.-1200 VC. T. 200 MA. 5V @ 3a—Two 6.3 VC.T fil. @ 3a ea. series these for 12 Volts to operate Xmtr. $5.95

FILAMENT TRANSFORMERS



Two Windings — Fully shielded sturdy construction. Originally made for RCA. 110 V. tapped primary. Secondary 5V. @ 3 a. and 6.3 V.C.T. @ 4 a. Size 2⅛"x3x2½". No. 9-201 Each $1.96

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Fully Shielded, R.C.A. type. Tapped primary for 115 V-60 cycle; 5v at 5a. Secondary — insulation satisfactory for operating high voltage rectifiers. Excellent for high grade amplifiers etc. Mtg. space 2½"x2⅝"x2⅞". Stock No. 9-408—Your cost 95c

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Hermetic Seal Shielded 50 M.A., 190 ohms—Real Buy, only 49c.
Case as Above size 2" X 2" X 3".

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Hvy. Duty closed cir. Jack 11c	Hardware Ass't. spade, solder, lugs, 2 lbs.....99c	75TL $2.49
7½ App. Line cord & plug 19c	Coil form grooved steatite 3" Dia. 5½" Long, ea....19c	8005 .... 3.95
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100' Stranded Aerial wire 29c	VOLUME CONTROLS All shafts ¼" Dia. ½" or Longer	809 .... 1.50
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Octal Mip Sockets 6c	20-1269 Dual 1 Meg., ea...25c	24G .... .59
6"-450 ohm dyn. speaker $1.49	Potentiometer wire wound 4500 ohms 1½" case.....39c	814 .... 4.50
5"-3.000 ohm dyn. speaker 1.49	Oil filled Condensers. Real buys. The types you fellows can use. Note: All condensers square cans except 600V type which is round inverted.	6AK5 .... .75
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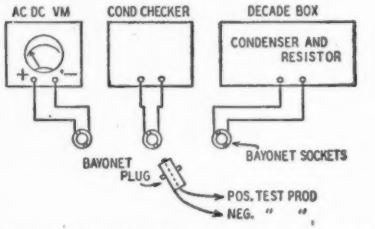
TRY THIS ONE

TEST LEAD POLARITY

A bayonet plug attached to the ends of a pair of test leads makes it possible to switch them to different instruments without the need for observing polarity.

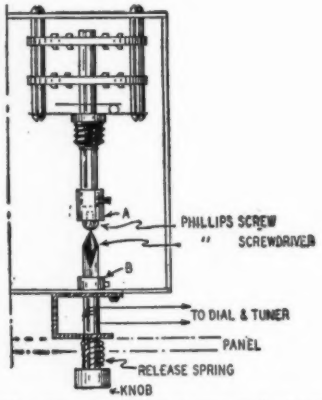


The negative lead is soldered to the shell of the plug and the positive lead attached to the center terminal. A bayonet socket is attached to each instrument. Inserting the plug into the socket makes the proper connection automatically.

JOHN J. MACGOWAN,
Minneapolis, Minn.

NOVEL BAND SWITCH

While constructing a two-band receiver, I used an idea for making the manual tuning control also serve as a band-switch control. The band switch was mounted at the rear of the chassis, its shaft directly in line with the tuning control shaft. The original tuning shaft was replaced with the blade of a Phillips-type screw driver, and the only other additions were a compression spring, a short Phillips-head screw, and two metal inserts salvaged from old knobs.



The screw was set in one end of insert A and soldered into place. The assembly was then attached to the band-switch shaft. The other insert B was then attached to the tuning shaft and placed to keep the driver point about ⅛ inch out-of-mesh with the screw.

To operate the switch it is necessary only to push the tuning knob in a bit and turn to the right or left. Upon release of pressure, the compression spring between knob and shaft bracket pulls the screw-driver end out of mesh, and stations are tuned in normal way.

OLIVER HORNUNG,
Chicago, Ill.

WIRE STRIPPER

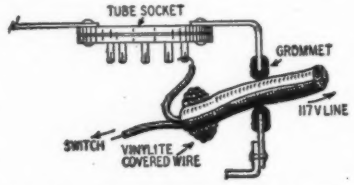
A metal photo clip makes a good wire stripper for hookup wire. Merely put the wire between the jaws of the clip, squeeze them together, and pull the wire out fully stripped.

This clip is also very handy for holding ends of wire together for soldering.

GEORGE WECHSLER,
Brooklyn, N. Y.

NON-SLIP LINE CORD

To anchor a thermoplastic-covered line cord simply and neatly inside the chassis, wind two or three layers of thin vinylite-covered wire onto the end of the line cord inside the set. With the flat side of a *clean* chisel-shaped soldering iron, heat the insulations of both the



cord and wire till their surfaces merge. When the wires cool, a smooth resilient skin will cover the anchor knot.

LUDWIG FURTH,
London, England

ODD SIZE RESISTORS

When I cannot obtain an odd-size value of resistor, I make one as follows: Roughen the surface of a small strip of 1/32-inch sheet mica and paint a line with India ink down the length of each side. Wrap two turns of No. 24 wire around each end of the strip and hold them in place with a conducting cement to assure a good connection. (This cement is made of powdered graphite mixed with coil dope to form a medium paste.) After the cement dries, coat the entire unit with thinned coil dope.

One resistor made in this way measured 47 megohms. Other values can be obtained by varying the amount of ink used or the size of the mica strip.

CHARLES J. APPLEGATE,
Champaign, Ill.

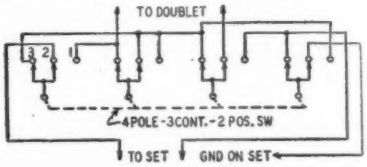
HEADPHONE REPAIR

When headphones become defective, almost always one of the coils is found to be open. This coil can be shorted out, allowing the current to pass through the other coil. The phones are less sensitive, but still usable till replacements can be obtained.

JOSEPH FIEDERER,
Worcester, N. Y.

ANTENNA SWITCHING

A simple doublet antenna is very effective for reducing noise on short-wave bands. However, an antenna of this type gives poor results on the broadcast band. To rectify this shortcoming, I used the arrangement shown, with good results. The switch is a 4-pole, 3-



contact, 2-position type. Throwing it from the first position to the second converts the doublet to a T antenna and makes all the necessary changes in connections to the receiver.

OTTO WOOLEY,
Colorado Springs, Colo.

COIL WINDING TIP

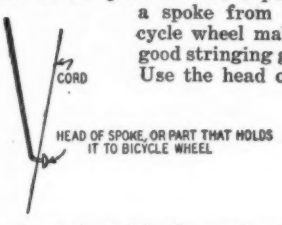
It is usually hard to thread the end of a thin wire through the pin of a coil form. But if the wire is first threaded through the eye of an ordinary sewing needle, the needle then can be used to pass the wire through the hole in the pin.

RALPH WALTER,
Jersey City, N. J.

(The fine wire also might be soldered to the end of a heavier wire.—*Editor)*

DIAL CORD REPLACEMENT

When a dial cord is difficult to replace because of the position of the pulleys, a spoke from a bicycle wheel makes a good stringing guide. Use the head of the



spoke to push or lift the cord over the pulleys that cannot ordinarily be reached.

GEORGE A. FELIX,
Valley Stream, N. Y.

FREQUENCY HALVING

It's easy to get on 80 meters even if you have only 40-meter crystals. Use a regenerative tetrode crystal oscillator, but plug an 80-meter coil into the socket of the plate tank circuit. The buffer and following stages should also use 80-meter coils. All the circuits are tuned to 80-meters, half the frequency of the 40-meter crystal.

Although tuning is somewhat critical, the stability is good and there are no chirps in the keying.

JOHN A. GLASS, W9SSW/Ø,
Bismarck, N. Dakota

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The Model 88-A *COMBINATION*

SIGNAL GENERATOR AND SIGNAL TRACER

The Model 88 comes complete with all test leads and operating instructions.

ONLY $28.85 NET

The ultimate in signal tracing procedure is achieved by the Model 88, for the use of this model, enables you to use either the broadcast signal itself or the signal injected by the Signal Generator. This is especially useful of course when servicing "dead" or "intermittent" receivers. The Model 88 you will find is the greatest time-saver ever provided for by combining a full range Signal Generator and Signal Tracer into one unit the set up time for interconnecting, etc., is entirely eliminated.

Signal Generator Specifications:

- ★ Frequency Range: 150 Kilocycles to 50 Megacycles.
- ★ The R.F. Signal Frequency is kept completely constant at all output levels. This is accomplished by use of a special grid loaded circuit which provides a constant load on the oscillatory circuit. A grounded plate oscillator is used for additional frequency stability.
- ★ Modulation is accomplished by Grid-blocking action which has proven to be equally effective for alignment of amplitude and frequency modulation as well as for television receivers.
- ★ Positive action attenuator provides effective output control at all times.
- ★ R.F. is obtainable separately or modulated by the Audio Frequency.

Signal Tracer Specifications:

- ★ Uses the new Sylvania 1N34 Germanium crystal Diode which combined with a resistance-capacity network provides a frequency range of 300 cycles to 50 Megacycles.
- ★ Simple to Operate—Clips directly on to receiver chassis, no tuning controls.
- ★ Provision is made for insertion of phones of any impedance, a standard Volt-Ohm Milliammeter or Oscilloscope.

The Model S-35

REFLEX PROJECTOR

COMPLETE with built-in driver unit conservatively rated at 35 watts—will handle up to 55 watts without blasting.

For the sound technician who demands the best in reflex speakers. Heavy gauge non-corrosive aluminum in the main trumpet section completely eliminates blasting and blaring. The Driver is conservatively rated at 35 watts and can safely handle 55 watts without blasting. It incorporates a number of new improvements. The standard metal diaphragm heretofore used has been replaced with a new plastic diaphragm. This overcomes the resonant peaks of the old type; also, because the new plastic diaphragm is absolutely impervious to atmospheric changes whereas the old type was subject to atmospheric corrosion we are enabled to guarantee the unit for one year. Model S-35 provides a maximum of coverage with a minimum of power thus reducing installation costs.

SPECIFICATIONS:

POWER (CONSERVATIVE)—35 WATTS; AIR COLUMN — 3½ FT.; DISPERSION — 80°; POWER (PEAK)—55 WATTS; BELL DIAMETER—15"; IMPEDANCE—8 OHMS; FREQUENCY RANGE—130 TO 5000 C.P.S.; PROJECTION—⅛ MILE; FINISH—ATTRACTIVE TWO-TONE CRYSTALLINE.

The Model S-35 Comes Complete with Built-in Driver Unit. ONLY **$28.50**

20% DEPOSIT REQUIRED ON ALL C.O.D. ORDERS

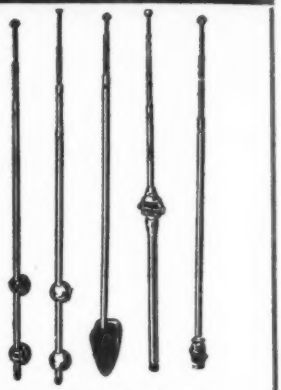
GENERAL ELECTRONIC DISTRIBUTING CO.

DEPT. RC-4 98 PARK PLACE, NEW YORK 7, N. Y.

RADIOMEN'S HEADQUARTERS WORLD WIDE MAIL ORDER SERVICE!!!

BUFRAD CAR RADIO ANTENNAS

All of our car radio antennas are made of triple plated Admiralty Brass Tubing, complete with low loss shielded antenna leads and high quality fittings.
SIDE COWL—BR-1, 3 sections extend to 66". Your price—single units—$1.50; in lots of 12—$1.35 ea.
SKYSCRAPER—BR-2 has 4 heavy duty sections that extend to 98". Your price—single units—$2.45; in lots of 12—$2.25 ea.
TILT ANGLE—BR-3, may be adjusted to all body contours. 3 sections extend to 66". Single unit price—$1.50; 12 lot price—$1.25 ea.
VERSATILE—BR-4, single hole fender or top cowl mounting may be adjusted to conform with all body contours. 4 sections extend to 56". Single unit price—$2.90; 12 lot price—$2.75 ea.
THE MONARCH—BR-5, single hole top cowl mounting, 3 sections extend to 56". Single unit price—$1.90; 12 lot price—$1.75 ea.
AFTER SEEING OUR ANTENNAS AND COMPARING, YOU WILL NEVER BUY ANY OTHER MAKE!



BR1 BR2 BR3 BR4 BR5

BENDIX SCR 522—Very high Frequency Voice Transmitter-Receiver—100 to 156 MC. This job was good enough for the Joint Command to make it standard equipment in everything that flew, even though each set cost the Gov't $2500.00. Crystal Controlled and Amplitude Modulated—HIGH TRANSMITTER OUTPUT and 3 Microvolt Receiver Sensitivity gave good communication up to 180 miles at high altitudes. Receiver has ten tubes and transmitter has seven tubes, including two 832's. Furnished complete with 17 tubes, remote control unit, 4 crystals, and the special wide band VHF antenna that was designed for this set. These sets have been removed from unused aircraft and are guaranteed to be in perfect condition. We include free parts and diagrams for the conversion to "continuously variable frequency coverage" in the receiver.

The SCR 522 complete with 24 volt dynamotor sells for only $37.95. The SCR 522 is also available with a brand new 12 volt dynamotor for only $42.95.

$9.95 TAKES ALL THREE BIG BARGAINS

1. AUDIO AMPLIFIER Undreamed of value. Uses 6V6's. Has 4 microphone inputs brought to jacks at rear panel. Various output impedances available at rear panel connections. Steel case with chrome handles. 9" long x 9" high x 6" deep. Tubes included. New in original carton. Shipping weight 20 lbs. **SUPER SPECIAL**—$4.95 while supply lasts.

2. RADIO HEADSETS Latest supersensitive type with rubber earpieces. Every pair guaranteed perfect. $.59 per pair OR 3 PAIRS FOR $1.00.

3. HOME WORKSHOP AT BARGAIN PRICE
Accurate and precise 2 speed guaranteed hobby lathe, the essential machine for the home workshop. Sturdy enough for light production work or factory standby service. Supplied with 56" of belting for connecting to any available electric motor or power take-off, such as on a jeep or tractor. Also included in this unbelievable offer are such accessories as a ½" drill chuck with specially hardened tool steel jaws, a 4" electric furnace high speed grinding wheel, a cotton buffing wheel with a large supply of buffing compound, and a 4" steel wire scratch brush. Your cost $6.00. Sole export agent. Distributor inquiries invited.

NO C. O. D.'s—ORDER NOW—DON'T DELAY

AUTO RADIO DEALERS! ATTENTION!

Nationally advertised brand of 1948 car radio which will fit practically any car and every pocketbook. Six tube superheterodyne with three gang condenser and 6½" speaker, **$32.20 for sample, or Dealer price $29.97 each, in lots of two or more.**
Here is an item that no serviceman who repairs auto radios should be without. Nationally advertised **ATR BATTERY ELIMINATOR** that supplies perfectly filtered 12 VDC or 6 VDC at 14 amp from 110 VAC **$36.00**

RADIO SERVICEMEN!! Buffalo Radio Supply's lower prices mean increased profits for you. Order all of your needs from us and receive in return courteous service and first class merchandise at the lowest prices in the country.

TUBES—All types in stock, 60% off on all tubes if ordered in lots of 10 or more.
TRANSFORMERS—All types in stock. **AUTO-TRANSFORMERS**; Steps up 110v, or steps down 220v to 110v—$1.95. **FIL. TRANS.**: 6.3v, 20 Amps.—$1.98; Universal Output Trans-8 Watt—89c; 18 Watt—$1.29; 30 Watt—$1.69. **AUDIO TRANSFORMERS**: S. Plate to S. Grid, 3:1—79c; S. Plate to P.P. Grids—79c; Heavy Duty Class AB or B, P.P. Inputs—$1.49; Midget Output for AC-DC sets—89c; **MIKE TRANSFORMER** for T-17 Shure microphone, similar to UTC ouncer type—$2.00 Stancor SB or DB mike to line or grid—$1.95.
POWER TRANSFORMERS—Half-shell type, 110V, 60 cy, Centertapped HV winding. Specify either 2.5 or 6.3V filament when ordering.

For 4-5 tube sets—650V, 40MA, 5V & 2.5 or 6.3V	$1.49
For 5-6 tube sets—650V, 45MA, 5V & 2.5 or 6.3V	1.75
For 6-7 tube sets—675V, 50MA, 5V & 2.5 or 6.3V	1.90
For 7-8 tube sets—700V, 70MA, 5V & 6.3 or two 2.5V	2.35
For 7-8 tube sets—700V, 70MA, 5V & 6.3 (25 Cycle)	3.00
For 8-9 tube sets—700V-90MA, 5V-3A, 2.5V-3.5A, 2.5-10.5A	2.85
For 9-11 tube sets—700V, 5V & 6.3V-4A	2.85
For 9-15 tube sets—600V, 150MA, 5V & 6.3V	2.95

CONDENSERS—PAPER TUBULAR 600 WV—.001, .002, .005—8c; .01, .05—9c; .1—10c; .25—23c; .5—35c; **ELECTROLYTICS**; 8mfd 200v—20c; 10mfd 35v—20c; 30mfd 150v—23c; 20/20mfd 150v—35c; 30/20 150v—46c; 50mfd 150v—43c; 8mfd 475v—34c; 16mfd 350v—65c; **OIL CONDENSERS**; 4mfd 600v 49c; 2mfd 600v—29c; 3X.1mfd 600v—29c.

SPEAKERS—These PM speakers are the finest that are available. All have heavy oversize Alnico V magnets.

3½"	$1.15	6 for	$6.60
4"	$1.15	6 for	$6.60
5"	$1.10	10 for	$9.50
6"	$1.50	6 for	$8.70
7" (Car Radio Size)	$4.50	6 for	$21.50
8" 10 oz.	$3.95	6 for	$20.50
8" 21 oz.	$4.95	6 for	$26.50
10" 21 oz.	$5.50	6 for	$30.00
12" 21 oz.	$7.95	6 for	$42.00

Cable Address: BUFRAD

FLUORESCENT LIGHT BALLASTS. Single 30 or 40 watt.$1.68; Dual 40 watt High Power Factor—$3.75.
HEADPHONES—Highest quality Signal Corps headsets with 12" cord and plug $1.25. 5' rubber covered patchcords with phone plug and socket—45c.
LINE FILTERS—110V—each unit contains two 2 mfd. oil filled condensers and a 15 amp. iron core choke. This filter has innumerable uses such as oil burner line filter, etc. A ten dollar value for 98c.
RT-1579 consists of a three stage cascade 6BJ7's and 6F6 output stage high gain, high fidelity amplifier with 60 cycle, 110V power supply on the same 13¾x14½ chassis, which is protected by a substantial steel cover over tubes and parts. Made by Western Electric with typical quality components such as a husky power transformer and oil condensers, this unit is obviously intended to give years of trouble-free service with no more need for repairs than a telephone. Disconnecting one wire each, from the special input and output filters, will result in as high a fidelity amplifier as can be obtained. Your cost with tubes, diagram and parts list included —$14.95.
RT-1655 — 11 tube crystal controlled superhet receiver for 24-28V DC operation. Beautiful chassis and cabinet. Uses latest tube types including 7 miniature 6AJ5's. Tubes and schematic supplied. Only a few available at $14.95

AT LAST YOU CAN AFFORD A LABORATORY STANDARD MICRO VOLTER

The famous Measurements Corp. Model 78B, 5 Tube Laboratory Standard Signal Generator (that sold new, FOB Boonton, N. J., for $310.00 net) is available in perfect condition for 25 to 60 cycle, 115 V AC operation. Until now this is the sort of topflight lab equipment that discriminating buyers have only vainly hoped would be released at a bargain price. Worth every cent the manufacturer asks, but available FOB Buffalo while our limited supply lasts for only $79.95.
Such companies as Admiral Corp. and John Meck, Inc., have ordered from us and repeated many times on these 78 generators for use in their labs and production line testing.

Model 78-B Standard Signal Generator. Two Frequency Bands between 15 and 250 megacycles.

"REMEMBER THAT A STANDARD IS ONLY AS RELIABLE AS ITS MAKER."

FILTER CHOKES: 200, 300, 400, 500 ohm light duty —59c; 200 or 300 ohm heavy duty—99c; 250 ma 35 ohm, made for U.S. Navy, fully shielded—$1.95; 75 ohm 125 ma—25c or 25 for $4.25; "Meissner type" tapped filter chokes—25c; 8 amp. iron core A filter—25c; Choke-condenser combination. Ideal to replace any size speaker field when installing PM speaker—79c.
110V. CIRCUIT BREAKERS of Magnetic type: Following Current Ratings in Stock: 1.25, 3, 4, 8 Amps. Please specify. $1.98 each.
SEVEN ASSORTED I.F. TRANSFORMERS—$1.98; Five Assrd. Oscillator Coils—89c.
SELENIUM RECTIFIERS—Dry disc type 1¼", 1", 1.2 Amp. maximum, suitable for converting DC relays to AC, for supplying filament source in portable radios, converting DC meters to AC applications, and also may be used in low current chargers—90c.
METER RECTIFIER—Full wave, may be used for replacement, or in construction of all types of test equipment—$1.25. Half Wave—90c.
FREE ! ! ! THIS MONTH ONLY
A HIGH GRADE CRYSTAL PICK-UP WITH THE PURCHASE OF EACH PHONO MOTOR AT $4.95.

MICROPHONES—All nationally known brands. Bullet crystal—$5.45; Bullet Dynamic—$7.45; Mike Jr.—60c; Handy Mike—90c; Lapel Mike—83c; SHURE T-17 MIKES, with push to talk switch—99c.
20 ASST'D COIL FORMS, including 11 ceramic, 3 polystyrene, and 6 fiber, all useful sizes—50c.
VARIABLE CONDENSERS: 350 MMFD, 5 gang—$1.95; 4 gang—$1.49; 3 gang—83c; 7.5 to 20 MMFD, 1750v spacing, extra long shaft Hammarlund—69c; miniature variables, 25 MMFD—39c; 50 MMFD—49c; 75 MMFD—59c; 100 MMFD—69c; 140 MMFD—79c.
INTERRUPTION FREQUENCY COILS for super-regenerative receivers or the tremendously popular FM adapters for standard broadcast sets. Iron core with a resonant frequency of 50 KC—39c; Air Core, 100 KC—29c.
30 MC IF TRANSFORMERS, double slug tuned—25c. **30 MC VIDEO AMPLIFIER PLATE COILS**—Slug tuned—25c.
REMOTE CONTROL UNIT: Aluminum case 4x3x2" containing 2 potentiometers, triple pole switch, 4 knobs, gear mechanism, counter and phone jacks—59c.
MODULATION TRANSFORMERS—10 watt, metal case 98c; 30 watt, open-type, $1.95; 40 watt, cast aluminum case, $2.95; Class "B" input transformers, cast aluminum case, $1.95; Transceiver audio transformers, 65c; Transceiver modulation transformers, 69c.
MINIATURE PLIERS SET contains one of each of the following: Needle nose, flat nose, parrot nose, standard nose. All contained in a leatherette case. Your cost—$1.98.
SOCKET WRENCH SET consisting of 5 sockets ranging in size from 5/16 to ½" and a handle—79c.
AUTOMATIC WIRE STRIPPERS will strip up to 1000 wires per hour, a handy tool for any service job —$3.52.

CLOSING OUT THE FOLLOWING DESIRABLE ITEMS AT SACRIFICE PRICES TO MAKE ROOM IN OUR WAREHOUSE FOR INCOMING STOCK

5" "SO" RADAR P.P.I. SCOPE, complete with 9 tubes including 807 tube in final power stage that provides deflecting current for magnetic yokes, Selsyn motor and self-contained 110 V. power supply designed to run on the AC supply on LST and PT boats. Various ranges from 2 to 80 miles. The most satisfactory scope available for navigational radar or panoramic television applications.—Nationally advertised as surplus at $100.00 by others. Our price, only $39.95.
AIRCRAFT MARKER BEACON RECEIVER—Complete with 8 tubes and sensitive relay to control external circuits from received signals. Just the receiver you have been waiting for to control models, open doors from a distance, etc. Priced at only $6.95.
LORAN INDICATOR OSCILLOSCOPE complete with 26 tubes and a 5" cathode ray tube. Greatly superior to other scopes because the multivibrator circuits incorporated can be used to present two traces simultaneously on screen. Thus input and output of an amplifier stage can be viewed at same time on screen. Distortion is indicated conclusively by difference between input and output traces, while fidelity is made evident by identical traces. Government instruction manual included.... $39.95

TERRIFIC VALUE — PORTABLE ELECTRIC DRILL

(Sold at less than established factory price so we cannot mention brand name)
Only $19.95 equipped with ¼" Jacobs Geared Chuck and Key. Not an intermittent duty drill, but a full size rugged tool. Most convenient type switch, natural grip handle, and balance like a six shooter.
Precision cut gears—turbine type cooling blower—extra long brushes.
No stalling under heaviest pressure because of powerful 110 Volt AC-DC motor and multiple ball thrust bearing.
Other bearings self-aligning lifetime-lubricated Chrysler Oilite type.
Made for toughest year-in and year-out service in plant or on construction jobs.
Amazing perpetual factory guarantee assures you of a lifetime of trouble-free use.
25% deposit on C.O.D.'s. Full refund (you pay transportation) if not pleased with drill after trial.

Minimum order $3.00—All prices subject to change—25% deposit with C.O.D. orders

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. 5 C. BUFFALO 3, N. Y.

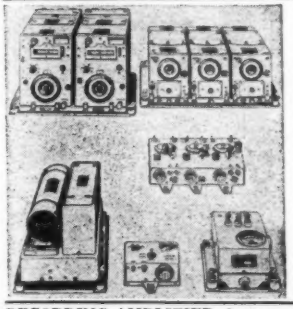
RADIOMEN'S HEADQUARTERS — WORLD WIDE MAIL ORDER SERVICE!!!

DUE TO POPULAR DEMAND WE REPEAT THESE TERRIFIC BARGAINS

Three assorted new **MICROPHONES**, including push-to-talk type $1.49
Ten assorted **R. F. Chokes** including high frequency types ..... $ .35
Five assorted **AUDIO or FILTER CHOKES** ..... $ .99
One Hundred assorted **RESISTORS** $1.95
Ten assorted **JAN CABLE CONNECTORS**, including SCR274,522 and BC375 types ..... $ .99
Six assorted **OIL FILLED CAN TYPE CONDENSERS**, all with mounting brackets $1.49
Ten assorted **METAL & BAKELITE KNOBS**—(no wooden knobs) ..... $ .39
Six assorted **VARIABLE CONDENSERS**, including butterfly types $1.49
Six assorted **POWER and AUDIO TRANSFORMERS**, all new $1.98
Six assorted isolantite and bakelite **R. F. COILS**, shielded and unshielded ..... $ .99

The above ten assortments totaling over $12.00 at the unbelievable bargain prices listed can be purchased together as one lot at a super-special total price of only $10.00. All merchandise guaranteed to be as advertised.

RT1463 7 tube amplifiers containing 3-7F7, 1-7Y4, 3-7N7, 4 potentiometers, numerous resistors, filter and bypass condensers, filter chokes, power and audio transformers, and six sensitive plate relays. A military development that provided amazing stepless control proportional to correction required for ailerons, rudder and elevator, in the original application. A control amplifier of the ordinary type would deflect the rudder by some arbitrary amount when the ship was blown off the course to port or starboard. The result would either be that the correction was insufficient and the plane continued off course, or the correction would be too great, starting a series of tackings and would greatly increase fuel consumption and elapsed time in reaching the objective. This phenomenal unit, with its 3 amplifiers and six 5000 ohm relays in bridge circuits, will accurately control any 3 operations, related or unrelated, in minutely adjustable uniquely quantitative variations in either forward or reverse directions. 9"x7"x8" black crackle aluminum case. Brand new in original carton. **$9.95.**



SCR-274N COMMAND SET
The greatest radio equipment value in history

A mountain of valuable equipment that includes 3 receivers covering 190 to 550 KC; 3 to 6 MC; and 6 to 9.1 MC. These receivers use plug-in coils, and consequently can be changed to any frequencies desired without conversion. Also included are two Tuning Control Boxes; 1 Antenna Coupling Box; four 28 V. Dynamotors (easily converted to 110 V. operation); two 40-Watt Transmitters including crystals, and Preamplifier and Modulator. 29 tubes supplied in all. Only a limited quantity available, so get your order in fast. Removed from unused aircraft and in guaranteed electrical condition. A super value at **$29.95**, including crank type tuning knobs for receivers. Without these knobs the receivers can't be tuned, and are only useful for parts. Don't buy without knobs! We also include one 60 cycle, 110 to 24V filament transformer for receiver—FREE.

RECORDING AMPLIFIER. 3 stage, 110 V, 25 or 60 cycle high gain amplifier built by recently bankrupt manufacturer specifically for recording use. Transformer for low impedance wire recorder head or magnetic cutter included on chassis. Tone and volume controls and switches on chassis for playback, recording or use as public address amplifier. Complete with tubes **$9.95**

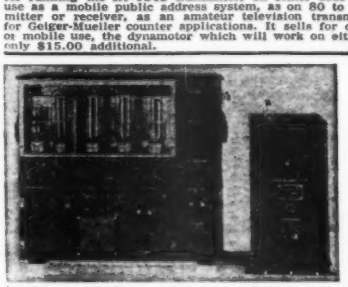
SCR-284 TRANSMITTER-RECEIVER — This medium power transmitter and the accompanying 7-tube very sensitive receiver are naturals for 80 or 40 meter operation (phone or CW), on either fixed stations or mobile applications. These units are brand new and come complete with 17 tubes, key, microphone, 200 KC calibrating crystal and instructions and diagrams for use with up to 100 watts input to the final stage on 40 or 80 meters for either phone or CW, using vehicle or 110 Volt power supply. Your cost **$39.95**

BRAND NEW INVERTERS AND DYNAMOTORS

PE 6A: A 24 to 32 V DC input, to 80 V. AC regulated output converter **$12.95**
PE 19A: A 24 to 28 V DC input, to 80 V AC at 800 cps output **$9.95**
(We include a stepup transformer with each of the above so that 110 V AC is available from either.)
27 V DC input 285 V DC @ 75 MA output ..... **.98c**
27 V DC input. Output 300 V @ 150 MA, 150 V @ 15 MA and 12 V @ 5 Amp. **$5.95**
12 V DC input. Output 300 V @ 150 MA, 150 V @ 15 MA and 12 V @ 5 Amp. **$12.00**
Il or 28 V DC input. Output 800 V DC, 400 V DC @ 135 MA, and 9 V AC **$15.00**
(By running on 6 V AC, 60 cycle input, with a small amount of DC for field excitation, the above dynamotor will provide a good source of 12, 24, 400 or 800 V DC.)

GENERAL ELECTRIC RT-1248 15-TUBE TRANSMITTER-RECEIVER

TERRIFIC POWER—(20 watts) on any two instantly selected, easily pre-adjusted frequencies from 435 to 500 Mc. Transmitter uses 5 tubes including a Western Electric 316 A as final. Receiver uses 10 tubes including 955's, as first detector and oscillator, and 3—7H7's as I.F.'s, with 4 slug-tuned 40 Mc. IF transformers, plus a 7H7, 7E6's and 7F7's. In addition unit contains 8 relays designed to operate any sort of external equipment when actuated by a received signal from a similar set elsewhere. Originally designed for 12 volt operation, power supply is not included, as it is a cinch for any amateur to connect this unit for 110V AC, using any supply capable of 400V DC at 135 MA. The ideal unit for use in mobile or stationary service in the Citizen's Radio Telephone Band where no license is necessary. Instructions and diagrams supplied for running the RT-1248 transmitter on either code or voice in AM or FM transmission or reception, for use as a mobile public address system, as on 80 to 110 Mc. FM broadcast receiver, as a Facsimile transmitter or receiver, as an amateur television transmitter or receiver, for remote control relay hookups, for Geiger-Mueller counter applications. It sells for only **$29.95** or two for **$53.90**. If desired for marine or mobile use, the dynamotor which will work on either 12 or 24V DC and supply all power for the set is only $15.00 additional.

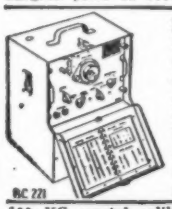


GENERAL ELECTRIC 150 WATT TRANSMITTER
Cost the Government $1800.00
Cost to you $44.50!!!!

This is the famous transmitter used in U.S. Army bombers and ground stations, during the war. Its design and construction have been proved in service, under all kinds of conditions, all over the world. The entire frequency range is covered by means of plug-in tuning units which are included. Each tuning unit has its own oscillator and power amplifier coils and condensers, and antenna tuning circuits—all designed to operate at top efficiency within its particular frequency range. Transmitter and accessories are finished in black crackle, and the milliammeter, voltmeter, and RF ammeter are mounted on the front panel. Here are the specifications: FREQUENCY RANGE: 200 to 500 KC and 1500 to 12,500 KC. (Will operate on 10 and 20 meter band with slight modification). OSCILLATOR: Self-excited, thermo compensated, and hand calibrated. POWER AMPLIFIER: Neutralized class "C" stage, using 211 tube, and equipped with antenna coupling circuit which matches practically any length antenna. MODULATOR: Class "B"—uses two 211 tubes. POWER SUPPLY: Supplied complete with dynamotor which furnishes 1000V at 350 MA. Complete instructions are furnished to operate set from 110V AC. SIZE: 21½x25x9¼ inches. Total shipping weight 200 lbs., complete with all tubes, dynamotor power supply, five tuning units, antenna tuning unit and the essential plugs. These units have been removed from unused aircraft but are guaranteed to be in perfect condition.

Minimum order $3.00—All prices subject to change—25% deposit with C.O.D. orders

Aluminum gear box 18x8x7 that contains two powerful electric motors and two matched gear trains, 62 gears in all varying in size from ½ to 4 inches in diameter. This unit is readily converted to rotate a beam antenna or any other similar usage..... **$3.00**
BRAND NEW 110 V AC INPUT POWER SUPPLY, in grey enameled shock-mounted case 9" x 10" x 16". Several heavy duty resistors, 3 chokes, 4-1000 V and 600 V oil-filled condensers, 1 relay, 2-5U4's, 3 voltage regulator tubes, safety interlock, and several fuses are included in this regulated power supply at the bargain price of **$9.95**

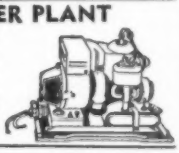


BC-221 FREQUENCY METERS with calibrating Crystal and calibration charts. A precision frequency standard that is useful for innumerable applications for laboratory technician, service man, amateur, and experimenter at the give away price of only **$36.95.**

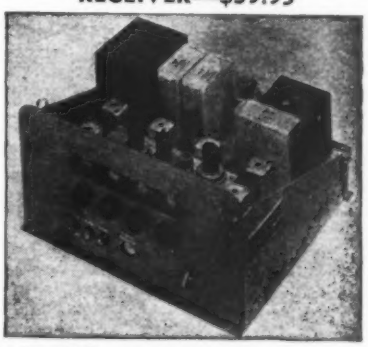
100 KC crystal calibrator kit containing everything that is necessary to construct a 100 KC osc. that will supply 100 KC marker points to your receiver so that it may be used for frequency determination. The 100 KC crystal is worth far more than the price that we are asking for the complete kit.
Kit 100K Plate and fil voltage supplied by receiver **$9.95**
Kit 100KA Same as above, including 110 VAC or DC self-contained power supply **$12.95**

PE-109 32-Volt DIRECT CURRENT POWER PLANT

This power plant consists of a gasoline engine that is direct coupled to a 2000 watt 32 volt DC generator. This unit is ideal for use in locations that are not serviced by commercial power or to run many of the surplus items that require 24-32V DC for operation. **The price of this power plant is only $58.95.** We can also supply a converter that will supply 110v AC from the above unit or from any 16-32V DC source for $12.95.



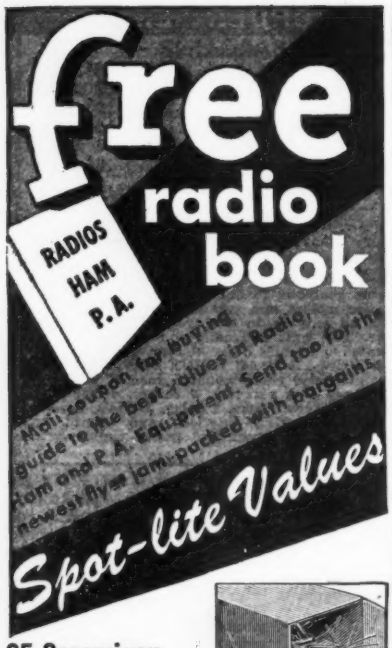
14-TUBE UHF SUPERHET RECEIVER—$39.95



This beautifully constructed receiver was designed especially for Signal Corps communication service, and is one of the finest and most sensitive sets ever manufactured. Operating from 110V 60 cycles, this set has two tuned RF stages, tuned converter and oscillator, *five I.F.* stages, using iron-core I.F.'s, a diode detector, tuning eye, and a two stage amplifier that will drive a speaker or phones. The frequency range is 158-210 Mcs. It is a simple matter to operate on other bands by making a slight alteration in the tuning coils. A complete set of tubes is included with each receiver, along with a circuit diagram and parts list. The high-voltage power supply delivers 150 milliamperes, and is well filtered by a heavy-duty choke and three 7 Mfd. oil-filled condensers. This buy of a lifetime cost the government about $700. Amateurs and experimenters will never again be able to purchase fine equipment at such a tremendous saving! See January *Radio-Craft*, Page 57, for complete conversion to television receiver.

Cable Address: BUFRAD

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. S C. BUFFALO 3, N. Y.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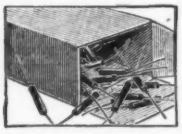

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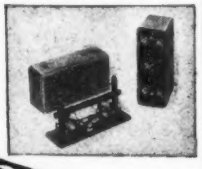

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New Radio-Electronic Patents

By I. QUEEN

MULTIPLYING MACHINE

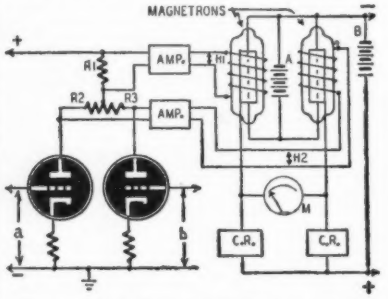
Jan A. Rajchman and George A. Morton, Princeton, N. J.
(assigned to Radio Corp. of America)
Patent No. 2,433,237

Magnetrons are well known as generators of high-power microwave energy. Here they have another important use. A pair of magnetrons is used with associated apparatus as an instantaneous multiplying machine.

A simple relation exists between the magnetic field of a magnetron and its anode voltage, when the anode current is maintained constant. For this type of operation, the anode voltage E is proportional to the square of the corresponding field H. We may write

$$E_1 = KH_1^2 = K(a+b)^2;$$
$$E_2 = KH_2^2 = K(a-b)^2;$$
$$E_1 - E_2 = K(H_1^2 - H_2^2) = 4abK.$$

The third term of each equation simply emphasizes the fact that any two numbers (or quantities like 1 and 2) may be regarded as the sum and difference of two other numbers. For example, 9 and 5 are the sum and difference of 7 and 2.



The equations show that if the magnetic field of one magnetron is made proportional to the sum of two voltages (a+b) and, if the field of the other magnetron is proportional to the difference (a—b), then the difference between anode potentials is proportional to the product (a × b).

Referring to the circuit diagram, 2 triodes are used as class-A amplifiers. The input voltages are a and b, respectively. Both plate currents flow through R1 in the same direction, therefore the voltage across it must be proportional to (a+b). Currents flow in opposite directions through the halves of resistor R2-R3, therefore the voltage across it is proportional to (a — b). These voltages are amplified and then connected across the magnetron field coils.

It is clear that H1 is proportional to (a+b) and that H2 is proportional to (a — b). The anode current of each magnetron is held constant by a current regulator. Then, by the previous equations, the difference between anode potentials must be proportional to the product (a×b).

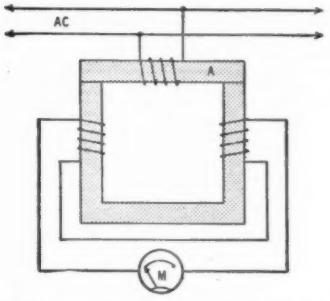
To operate the calculator, input potentiometers are adjusted to apply desired potentials to the amplifying tubes. The product is read off at once on the calibrated meter M.

COIL TESTER

Joseph K. Thompson, Pittsburgh, Pa.
(assigned to Westinghouse Elec. Corp.)
Patent No. 2,432,948

This is an improvement in the method of testing coils by comparison. In the usual method the coils are placed on opposite legs of a transformer core in which an alternating field is produced. The coils are connected in series so that the current induced in one bucks that in the other. A meter connected in the circuit will read zero if the coils are identical.

Usual practice is to place the standard and unknown coil on the opposite legs of a U-shaped core. The a.c. winding is on the bottom of the U. A fourth and removable side completes the magnetic circuit. This method, while convenient, leaves air gaps which are effectively in parallel with the usual leakage gap. Since the air gaps cannot be made exactly alike, the magnetic flux through the core legs is not the same.



In this method the primary is wound on the removable side (A) of the core. The air gaps are now *in series* with the core, and cannot cause unequal flux through the core legs.

RADAR TELEVISION

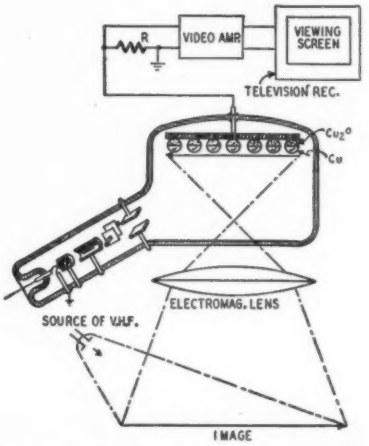
James W. Gibson, Avenel, N. J.
(assigned to Western Electric Co.)
Patent No. 2,429,933

Radar and television may be combined to form images and scenes otherwise invisible to the naked eye. Short radio waves are directed against the desired target. Reflected energy is picked up and converted into electric currents. These are video currents which may be used to control a television receiver.

The reflected radio waves are focused by an electromagnetic lens made of material having a high dielectric constant. A porcelain lens can be designed to have a radius of curvature of 18 feet and a focal length of 3.74 feet. Such a lens forms an image 2 feet square from a scene 5 miles square at a distance of 50,000 feet.

The focused image is made to fall upon a mosaic within a vacuum pickup tube. This mosaic is made of tiny rectifying elements attached to a plate. Each element is spherical in shape. The exposed portions of each element are made of copper and the parts which contact the plate are of copper oxide. When electromagnetism travels through these elements, they induce currents which are rectified. Positive charges appear on the exposed parts, and the plate becomes negative.

An electron beam is caused to scan the mosaic as in a conventional television tube. As this beam strikes an element it causes the latter to discharge through resistor to ground and back to the tube cathode. These video currents are amplified and reproduced.



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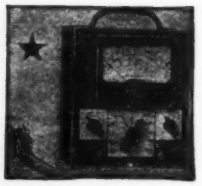

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HIGH FIDELITY AMPLIFIERS

(Continued from page 36)

Since Xcs/Req = 2 at 90% level, Req equals 44,247 ohms. Plate resistance and grid leak are 1,000,000 ohms and 500,000 ohms, therefore we solve for the plate load or coupling resistor RL in the equation

$$Req = \frac{RL \times Rp \times Rg}{RL \times Rg + RL \times Rp + Rg \times Rp},$$

where Rp is the plate resistance and Rg is the grid leak of the 2A3. The equation calls for a 51,019-ohm resistor. In practice we use a 50,000-ohm resistor.

Voltage amplifier stage

The 6SJ7 has a gain of 61.9, G = gm × Req, and the signal on its grid voltage must equal its output voltage divided by its gain or 45/61.9 = 0.72 volt peak.

When the low-frequency response is down 1 db from mid-band level, the reactance of the coupling condenser Xcc is one-half the resistance R formed by considering the grid leak of the 2A3 in series with the coupling and plate resistances in parallel. R equals

$$Rg + \frac{(Rp \times RL)}{Rp + RL}.$$

We find R is 504,761 ohms, so Xcc is ½R or 252,380 ohms. A .031-μf condenser has this reactance at 20 cycles. A larger condenser—a .05 μf for example—may be used.

The cathode bias (3 volts) for the 6SJ7 is developed across an 800-ohm cathode resistor. The value of the cathode bypass condenser is computed by following the methods applied to the 2A3.

The screen resistor drops the voltage on the screen grid to 100. Its value may be calculated from Ohm's law. Screen-grid degeneration is held to a negligible value by making Rsg × C equal or greater than 3/f, when Rsg is the screen-grid resistor in ohms, C is the screen bypass in *farads*, and f is the lowest desirable frequency (20 cycles). A 250,000-ohm resistor was used in the circuit shown. Since 250,000 × C equals 3/20, C is .0000006 farad or 0.6 μf. Degeneration decreases as C is made larger, so a 1-μf condenser may be used.

A 1-megohm resistor is permissible in the grid circuit of the 6SJ7. Therefore one is used to decrease the shunting effect of capacitance across its input circuit.

Another stage

Our signal source develops .015 volt r.m.s. (.021 volt peak), so added gain is needed to raise this to the 0.72-volt level at the grid of V2. Another 6SJ7 was selected for the job, and circuit constants were designed in the same manner as those of V1 and V2. Note that the load resistor of V3 is much larger than that of V2. This is because Miller

(Continued on page 58)

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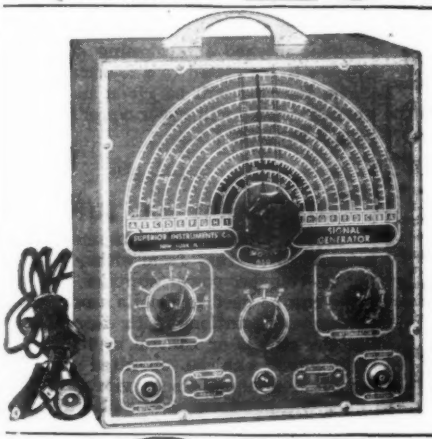

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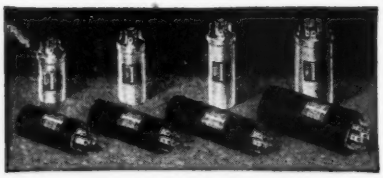

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HIGH FIDELITY AMPLIFIERS

(Continued from page 56)

effect is negligible in pentodes. The shunting reactance between V3 and V2 is the sum of the output capacitance of V3, the input capacitance of V2, and stray capacitance. The gain of V2 is ignored in this case. Using constants from the tube manual and assuming 10-μμf stray capacitance, we find a 265,000-ohm coupling resistor may be used. This permits V3 to develop a gain of 242—about seven times more than is required in the specifications. The additional gain available from V3 is useful in overcoming circuit losses which may be caused by reduced operating voltages and component ageing.

Feedback and motorboating

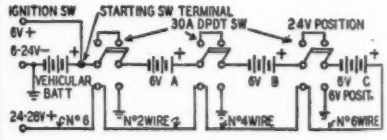
Degeneration and motorboating are likely to occur when three or more amplifier stages are operated in cascade from a common power supply. This is caused by the plate circuits being coupled through the impedance of the power supply and is eliminated by using a decoupling filter Rf and Cf in the plate circuit of V3.

In a.f. circuits, decoupling constants are selected by making Rf equal to one-tenth the value of the coupling resistor—greater where power supply voltage permits. The decoupling condenser is selected to have a reactance of Rf/20 or less.

This method of designing decoupling filters is restricted to a.f. circuits. Reasons for this will be given in the next article which will cover amplifiers having a range of 6 mc.

UNIVERSAL D.C. SUPPLY

Most surplus radio equipment is designed to operate from either 12-, 24-, or 28-volt d.c. power supplies. Much of this can be used in mobile amateur and emergency stations with few changes in the circuit or control systems. Such equipment can be operated from its original dynamotors or vibrapack supplies without troublesome alterations or conversions.



If 12-volt equipment is used, install a 6-volt storage battery in series with the vehicular 6-volt battery. Use a s.p.d.t. switch in place of the d.p.d.t. unit between batteries A and B. For 24- to 28-volt equipment, use 3 auxiliary storage batteries and switches as shown. The batteries are in series for 24-volt operation and in parallel for 6-volt service, charging from the automobile generator. The wire sizes shown on the diagram are the smallest that should be used under normal conditions.

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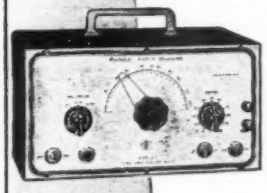

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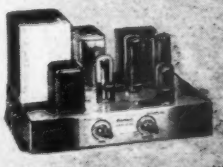
Small portable 9" x 6" x 4¾". Wt. 6 pounds. Ideal for taking on service calls. Complete your service shop with this instrument.



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Order today while surplus tubes make the price possible.

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SIGNAL GENERATOR

(Continued from page 37)

(See Table II). The coil which covers the range from 400 to 550 kc has a 500-μμf fixed condenser across it to extend the low-frequency range.

There are four coils, covering a range from 100 kc to 18 mc. Only the 400-550-kc coil is shown. As shown, a lead from the grid of the 6K8 is run to the open terminal of one of the switches in each push-button unit, and one from the plate to that of the other switch. The hot ends of the two coils in each unit are connected to the moving arms of the switches, and the other ends of the coils to ground. The other open terminals of the switches are connected directly to grounds.

In the normal, or open, switch position, all coils are shorted to ground. Pushing any button from 2 to 5 puts the corresponding coil in the circuit and disconnects any coil that is already in the circuit. *(Caution: do not push more than one coil button at a time. More than one coil in the circuit causes incorrect calibration.)*

To save the work of winding, standard 175-kc, 455-kc, broadcast and short-wave coils of the commercial type may be used, with some change in the ranges. By removing turns or increasing their

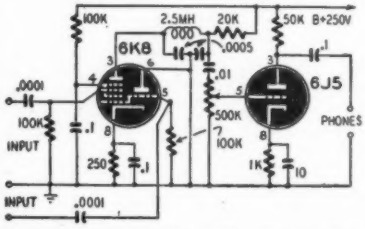

Fig. 3—Circuit of the calibration monitor.

number the proper frequencies may be covered and good oscillation characteristics obtained.

To permit changing tubes without having to recalibrate the oscillator, a 5-15-μμf trimmer condenser is connected in parallel with the main tuning condenser.

A 1-ma meter connected between the grid leak and the cathode of the 6K8 will read the oscillator grid current, which should be about 100 to 150 μa. This current should vary as little as possible over the entire frequency range.

The oscillator may be calibrated by tuning the signal in on a properly aligned communications receiver and marking the frequency on the dial. Or the simple calibration monitor shown in Fig. 3 may be used in conjunction with an already calibrated signal generator. This monitor uses a 6K8 as a mixer and a 6J5 or 6C5 as an audio amplifier. The unmodulated signals from the oscillator and signal generator are injected into the two grids, and the signals listened to on the phones. When the signals zero beat, the frequency of the oscillator is the same as the signal generator's. By using this method, the oscillator can be calibrated point by point.

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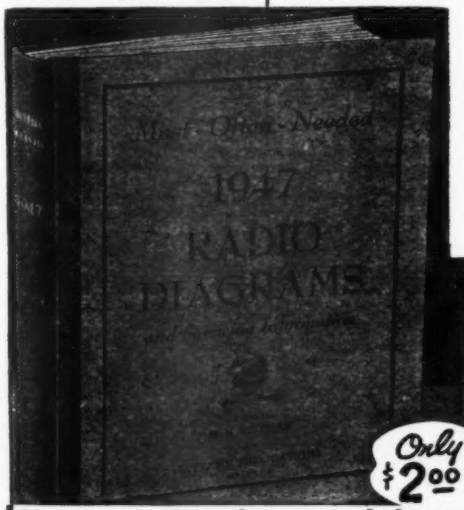

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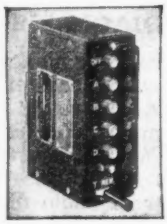

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.006—600V Postage Stamp

Each 5c

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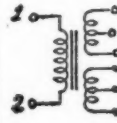
OUNCER TRANSFORMER

as per Schematic



1-2	1 ohm D.C. Res;	25 ohm. Imp.
3-4	220 ohm D.C. Res.	3-5 500 ohm. Imp.
4-5	235 ohm D.C. Res.	
6-7	350 ohm D.C. Res.	6-8 2000 ohm. Imp.
7-8	400 ohm D.C. Res.	

Special at 35c ea. 10 for $2.95

ing crystals (or properly biased diode tubes) connected oppositely and in parallel (Fig. 2). The a.f. currents are not rectified because they can flow in either direction. Each crystal has a fairly constant resistance when more than 0.5 volt is applied across it, but below this value its resistance rises sharply. When the voltage is very low, as it is when only background noise is present, there is practically no transmission. Medium and loud speech or music will pass freely, however, along with whatever noise may be present at the time, Such noise is then masked effectively by the desired signal.

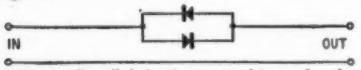


Fig. 2—Parallel diodes control input levels.

This system reduces noise and requires only a simple circuit. Unfortunately, the output cannot sound exactly like the input since the transmission is non-linear. Harmonics and beats are introduced along with the original frequencies. However, spurious responses are at least one octave removed from its original frequency. Filters can therefore be used to eliminate the undesired harmonics.

NOISE REDUCTION

(Continued from page 23)

Two filters are used for maximum effect, one at the input and the other at the output of the channel. Each is designed to attenuate response outside of a given octave. To cover the whole audio range, many separate octave-filtered channels in parallel must be used. However, the higher frequencies carry most of the noise, so the lower sound register (up to several kc) may be transmitted through a separate parallel channel with no need for noise reduction.

For home reproduction of phonograph selections two channels are sufficient. One can pass up to 3 kc with no noise reduction. The other can be an octave-filtered channel transmitting 3-6 kc. For still higher fidelity, more channels are required. One circuit has been designed with four channels. Three of them are filtered to transmit the following octaves respectively: 1.5-3 kc; 3-6 kc; 6-12 kc. The other channel is a low-pass network which transmits frequencies below 1.5 kc. Block diagram appears in Fig. 3.

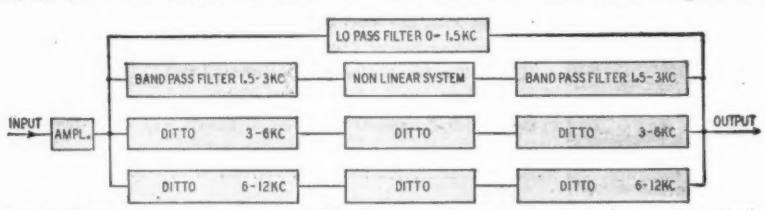


Fig. 3—Olson noise reducing system. Only two channels are required on home phonographs.

Advantages claimed for the octave-transmission system are: There is no audible "swish" due to time constants because the circuit operates instantaneously. Furthermore, the output level is identical with the input for volume greater than the threshold value. Finally, the circuit requires practically no maintenance and is easy to operate.

The author will be pleased to answer any questions in connection with the above article. Simply address I. Queen, care of this magazine.

POLARITY TESTER

On a.c. operated instruments, it is often necessary to determine the line polarity to avoid shocks and possible damage to meters and components. Determine which prong of the line plug must be grounded and solder one terminal of a small neon lamp to it. To the other terminal of the neon lamp attach a short piece of wire with an insulated phone tip at the end. Insert the plug into the outlet and touch the phone tip to the grounded plate or screws of the outlet box. If the lamp lights, reverse the plug.

The lamp is very small and fits neatly into a recess cut in the body of the plug. The plug is wrapped with transparent tape to hold the lamp firmly.

J. SIMRIN,
New York, N. Y.

WORLD-WIDE STATION LIST

Edited by ELMER R. FULLER

REPORTS were received this month from Gil Harris of Massachusetts; Charles Edwards of Massachusetts; Charles H. Fuller of New York; the Department of State; and the Canadian Broadcasting Corporation. Several new frequencies are now in use by the U. S. shortwave stations. The log this time went to press before the information was received and therefore the necessary changes were not made. The following information supplements that given in the list:

WRUW, Boston, on 11.720 to Central America from 1730 to 1900 and 2000 to 2400 hours, EST. WRUX, Boston, 17.750 to Europe from 1435 to 1715 hours. WLWR2, Cincinnati, 15.330 from 1800 to 2400 to South America. KCBF, Delano, 9.700 to Japan and China from 0400 to 0930 hours. KCBR, Delano, 9.750 to the Philippines and the East Indies from 0400 to 1005 hours. KCBF, Delano, 11.810 to Alaska from 2000 to 2200 and 2215 to 2400. KNBA, Dixon, 6.060, to Hawaii from 0400 to 1005. KNBI, 6.120, to China and Japan from 0400 to 1005. KNBX, Dixon, 11.790, to China and Southeastern Asia from 0400 to 1005.

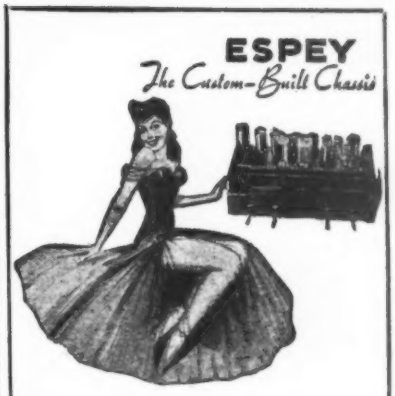
KNBX, Dixon, 15.250, to South Pacific islands from 0030 to 1700 and to South America from 1900 to 2400. WCDA, New York City, 11.830 to Mexico from 2000 to 2200. WCBN, New York City, 15.270 from 1115 to 1630 to Europe and to South America from 1645 to 1700. WCBX, New York City, 17.830 to Europe from 1115 to 1630; to South America from 1645 to 1700 and 1800 to 1900, and to Brazil from 2000 to 2200. WNRI, New York City, 18.160, to Europe from 1000 to 1800. WCRC, New York City, to Europe from 1100 to 1630; to South America from 1645 to 1700. KGEX, San Francisco, 11.730 to the Philippines from 0030 to 0345 and to the East Indies from 0400 to 1005. KWIX, San Francisco, 11.860, to Japan and Korea from 0400 to 0930. WGEO, Schenectady, 15.330, to Europe from 1115 to 1730.

Location	Station	Freq.	Schedule
UNITED STATES			
Boston, Mass.	WRUS	6.040	Mexican beam, 2000 to 2400
Boston, Mass.	WRUX	9.540	Central American beam, 1725 to 1800
Boston, Mass.	WRUW	9.570	South American beam, 2000 to 2200
Boston, Mass.	WRUS	9.570	European beam, 1430 to 1805
Boston, Mass.	WRUW	11.720	Central American beam, 1730 to 1900; 2000 to 2400; Sundays, 1730 to 1800; 2000 to 2400
Boston, Mass.	WRUL	11.720	Central American beam, 2000 to 2400
Boston, Mass.	WRUW	11.730	European beam, 1435 to 1715
Boston, Mass.	WRUA	11.790	European beam, 1430 to 1805
Boston, Mass.	WRUA	15.200	European beam, 1100 to 1400
Boston, Mass.	WBOS	15.210	European beam, 1100 to 1700; South American beam, 2000 to 2200
Boston, Mass.	WRUA	15.290	Central American beam, 2000 to 2400
Boston, Mass.	WRUL	15.290	European beam, 1115 to 1715; South American beam, 1730 to 1900 Sundays to 1800
Boston, Mass.	WRUX	17.750	European beam, 1435 to 1715
Boston, Mass.	WRUW	17.750	European beam, 1115 to 1450
Boston, Mass.	WRUX	25.600	African beam, 1330 to 1400
Cincinnati, O.	WLWS1	6.080	West South American beam, 1900 to 2400
Cincinnati, O.	WLWO	9.590	European beam, 1530 to 1700
Cincinnati, O.	WLWS2	9.700	South American beam 1900 to 2400
Cincinnati, O.	WLWS1	11.700	European beam, 1515 to 1700
Cincinnati, O.	WLWS2	11.700	North African beam 1515 to 1700
Cincinnati, O.	WLWR1	11.710	South American beam 1800 to 2400; Sundays 1900 to 2400
Cincinnati, O.	WLWO	11.790	South American beam 2000 to 2200
Cincinnati, O.	WLWK	15.250	European beam, 1200 to 1700

(Continued on page 64)

Suggested by: Glenn Parker, Whiteville, Tenn.

"He services all the midget sets."



How many times have you wished you could replace that worn out AM set now housed in a beautiful, highly thought-of cabinet? At last it's possible—and at a price within the reach of everyone! The **ESPEY** line of custom-built chassis is designed for just such installations, as well as for custom-built and other special applications. Take the **ESPEY MODEL 7-B,** for instance. It's a top-quality AM-FM receiver, featuring high fidelity reception, illuminated slide rule dial, full tone control, and is wired for phonograph operation.

Its superheterodyne circuit contains 10 tubes plus a rectifier tube, and operates on 105/125 volts AC, 50/60 cycle. Furthermore, it's supplied ready to operate, with 10" speaker containing an Alnico No. 5 magnet, both AM and FM antennas, and all hardware needed to make the installation easy and complete.

For full details write to Dept. C

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A LISTENING SHELL

An artillery shell that listens and records what it hears is the invention of three inventors in the New York area, Harvey Fletcher, John F. Muller and Karl D. Swartzel, Jr. The projectile was originally intended as a means for testing the possibility of producing audio-proximity fuzes for anti-aircraft shells, instead of the radio-proximity ones finally adopted. Compact, rugged microphones, hooked to recording apparatus, were installed in the noses of the shells to trace wavy lines representing the shells' own sounds, plus the noise of airplane motors which they might be approaching. The patent, No. 2,436,384, has been assigned to the Bell Telephone Laboratories.

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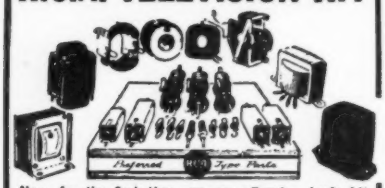

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KIT CONSISTS OF:

- Deflection Yoke Type 201D1
- Width Control Type 201R1
- Horizontal Linearity Control Type 201R3
- Power Transformer Type 201T6
- Yoke Mounting Hood Type 201X1
- Focus Coil Type 202D1
- Vertical Output Transformer Type 204T2
- Filament Choke Type 204L1
- Television I.F. and Video Coil Kit Type 204X2
- Vert. Blocking-Oscillator Transformer Type 208T2
- Horiz. Blocking-Oscillator Transformer Type 208T3
- Horiz. Output Transformer Type 211T1

SPECIAL $69.50 COMPLETE

The parts in this kit, if purchased separately, would list at over $139.00. Niagara saves you over 50%, or a big $70.20. GET YOURS TODAY.

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A 26 page instruction book, including a large 12 by 18 schematic diagram, theory of television, circuit functions, explanation of scanning, preliminary volt. measurements, parts lay-out and final adjustment of the television receiver which facilitates easy alignment without the use of elaborate test equipment comes with each unit.

If you are a radio man you will probably have all of the minor parts not included in this foundation kit. By following the simple schematic diagram and instructions you can thus build a television receiver at many dollars savings.

The above Kit with parts as mentioned	$34.75
The above Kit with 7EP4 for an additional	12.95
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160 Greenwich St., New York City 6, N. Y.

WORLD-WIDE STATION LIST

(Continued from page 63)

Location	Station	Freq.	Schedule
Cincinnati, O.	WLWR	15.330	South American beam, 1800 to 2400; Sundays, 1900 to 2400
Cincinnati, O.	WLWR	15.350	European beam, 1300 to 1700
Cincinnati, O.	WLWR	15.350	North African beam, 1300 to 1700
Cincinnati, O.	WLWO	17.800	European beam, 1200 to 1515
Cincinnati, O.	WLWK	17.800	South American beam, 2000 to 2200
Cincinnati, O.	WLWS	21.650	European beam, 1200 to 1500
Cincinnati, O.	WLWS	21.650	North African beam, 1200 to 1500
Cincinnati, O.	WLWL	21.690	European beam, 1100 to 1700
Delano, Cal.	KCBA	6.170	Guam-Philippine beam, 0400 to 0930
Delano, Cal.	KCBF	9.700	Japanese-Chinese beam, 0430 to 0930
Delano, Cal.	KCBR	9.750	Philippine-East Indies beam, 0400 to 1005
Delano, Cal.	KCBR	15.130	South American beam, 1900 to 2400
Delano, Cal.	KCBA	15.150	Alaskan beam, 2215 to 0345
Delano, Cal.	KCBF	11.810	Alaskan beam, 2215 to 0345
Delano, Cal.	KCBA	21.460	South American beam, 1900 to 2400
Dixon, Cal.	KNBA	6.060	Hawaiian beam, 0400 to 1005
Dixon, Cal.	KNBI	6.120	Chinese-Japanese beam, 0400 to 1005
Dixon, Cal.	KNBA	9.650	Hawaiian - Australian beam, 0230 to 0345; off Mondays
Dixon, Cal.	KNBI	9.700	Chinese beam, 0230 to 0345
Dixon, Cal.	KNBX	11.790	Chinese-Southeast Asia beam, 0400 to 1005
Dixon, Cal.	KNBX	15.250	South Pacific beam, 0030 to 1700; South American beam, 1900 to 2400
Dixon, Cal.	KNBI	17.770	South American beam, 1900 to 2400
New York City	WCBN	9.650	South American beam, 2000 to 2200
New York City	WNRX	9.670	Brazilian beam, 1800 to 1900; 2000 to 2200
New York City	WOOW	9.700	European beam, 1515 to 1800
New York City	WCDA	11.730	Mexican beam, 2000 to 2200
New York City	WNRX	11.830	European beam, 1400 to 1700
New York City	WNRA	11.870	European beam, 1515 to 1800
New York City	WOOC	15.130	European beam, 1000 to 1800
New York City	WRCA	15.150	European beam, 1100 to 1700; Brazilian beam, 1800 to 1900; 2000 to 2200
New York City	WCBN	15.270	European beam, 1115 to 1630
New York City	WCRC	15.270	South American beam, 1900 to 2400
New York City	WNRE	15.280	European beam, 0500 to 1815
New York City	WNBI	17.780	European beam, 1100 to 1800; South American beam, 1900 to 2400
New York City	WCBX		European beam 1115 to 1630; South American beam, 1645 to 1700; 1800 to 1900; Brazilian beam, 2000 to 2200
New York City	WNRI	18.160	European beam, 1000 to 1800
New York City	WOOW	21.500	European beam, 1100 to 1500
New York City	WCRC	21.570	European beam, 1100 to 1630; South American beam, 1645 to 1700
New York City	WNRA	21.610	European beam, 1000 to 1500
New York City	WNRX	21.730	European beam, 1100 to 1330
San Francisco	KGEI	9.530	Mid-Pacific beam, 0030 to 0530; Philippine beam, 0545 to 0930
San Francisco	KWID	9.570	Chinese beam, 0700 to 1000
San Francisco	KWIX	9.570	Alaskan beam, 2215 to 0345
San Francisco	KGEI	9.670	South American beam, 2230 to 2400
San Francisco	KGEX	11.730	Philippine beam, 0030 to 0345; Philippine - East Indies beam, 0460 to 1005
San Francisco	KWIX	11.860	Japanese-Chinese beam, 0400 to 0930
San Francisco	KWID	11.900	South Pacific beam, 0030 to 0630
San Francisco	KWID	17.760	South American beam, 1900 to 2400
San Francisco	KGEX	17.880	South American beam, 1900 to 2400
Schenectady	WGEO	9.530	South American beam, 1900 to 2400
Schenectady	WGEX	9.670	European beam, 1530 to 1700
Schenectady	WGEA	11.770	European beam, 1415 to 1805
Schenectady	WGEA	11.810	Brazilian beam, 2000 to 2200
Schenectady	WGEO	15.330	European beam, 1115 to 1730
Schenectady	WGEX	17.880	European beam, 1100 to 1515
UNITED STATES			
Schenectady	WGEA	21.590	European beam, 1115 to 1400
Washington	WWV	2.500	U. S. Bureau of Standards; continuously
Washington	WWV	5.000	U. S. Bureau of Standards; continuously day and night
Washington	WWV	10.000	U. S. Bureau of Standards; continuously day and night
Washington	WWV	15.000	U. S. Bureau of Standards; continuously day and night
Washington	WWV	20.000	U. S. Bureau of Standards
Washington	WWV	25.000	U. S. Bureau of Standards; continuously day and night
Washington	WWV	30.000	U. S. Bureau of Standards; continuously day and night
Washington	WWV	35.000	U. S. Bureau of Standards; continuously day and night
U.S.S.R.			
Kiev		11.720	0700 to 0815
Komsomolsk		9.560	2100 to 2400
Moscow		5.810	schedule unknown
Moscow	RV15	5.940	2300 to 1000
Moscow		6.030	schedule unknown
Moscow		9.680	1600 to 1745; 2315 to 2345
Moscow		7.300	1300 to 1800; 1815 to 2100
Moscow		9.480	2200 to 0200
Moscow		9.710	2300 to 0730
Moscow		11.630	1930 to 0300; 0600 to 0800; 0830 to 1300
Moscow		11.780	0900 to 1000; 2000 to 2130; 2200 to 0100
Moscow		11.830	2200 to 0600; 0730 to 0845; 1100 to 1600
Moscow		11.880	1820 to 1930; 2000 to 2045
Moscow		15.320	0000 to 0500; 0530 to 0800; 0830 to 1100; 2200 to 2300
Moscow		15.340	2200 to 0800; 1000 to 1100
Moscow		15.230	0745 to 0815; 1820 to 1930; 2000 to 2130; 2200 to 0200
URUGUAY			
Montevideo	CXA6	9.620	1530 to 2100
Montevideo	CXA19	11.830	0600 to 2200
Montevideo	CXA10	11.900	1830 to 2115
VATICAN CITY	HVJ	5.970	1000 to 1100
VATICAN CITY	HVJ	11.740	0015 to 0025; 0830 to 0900; 1100 to 1145
VATICAN CITY	HVJ	15.120	0830 to 0930; 1100 to 1145
VATICAN CITY	HVJ	17.440	0715 to 0845
VENEZUELA			
Barquisimeto	YV3RS	3.490	1630 to 2130
Barquisimeto	YV6RC	3.510	1800 to 2130
Barquisimeto	YV3RN	4.990	0630 to 2230
Caracas	YV5RY	3.380	0930 to 2230
Caracas	YV5RW	3.400	0630 to 2230
Caracas	YV5RX	3.500	0930 to 1400; 1530 to 2230
Caracas	YV5RS	3.530	0530 to 2230
Caracas		4.920	0600 to 2230
Coro	YV1RY	4.770	1600 to 2130
Maracaibo	YV1RT	3.370	1730 to 2230
Maracaibo	YV1RU	3.440	1900 to 2130
Maracaibo	YV1RV	4.750	1730 to 2130
Maracaibo	YV1RL	4.810	0530 to 2230
Maracay	YV4RK	3.390	1800 to 2230
Merida	YV2RC	3.420	1800 to 2130
Puerto Caballo	YV4RQ	3.480	1700 to 2130
San Christobal	YV2RN	4.830	1100 to 2130
Trujillo	YV1RO	3.310	1700 to 2130
Valencia	YV4RP	3.460	1730 to 2130
Valencia	YV4RQ	4.780	1630 to 2130
Valera	YV1RZ	4.840	1630 to 2145
YUGOSLAVIA			
Belgrade		9.420	0000 to 0230; 0630 to 0845; 1110 to 1125

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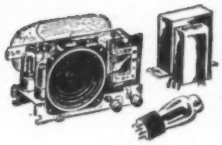

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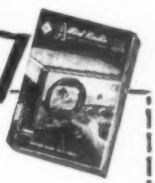

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One model will replace all the following types: L22, L25, L26, L27, L32, L40, L70, L75, L76, W41A, W-42A, W57A. Size $\frac{7}{16}$" x ¾" x 2$\frac{5}{16}$". List price $4.45. THEY COST YOU $1.39 10 for $12.90

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Serviceshop Tests Serviceshops

By ERIC LESLIE

"KNOWLEDGE Precedes Intelligent Action." This old proverb is truer in radio than in almost any other branch of modern industry. The progressive radio technician is an avid reader of radio magazines, books and manuals and a steady patron of radio-electronic schools. These are available in quantity, so he has little difficulty in keeping abreast of the technical advances in radio.

But when it comes to setting up a business of his own—to actually establishing a service shop—the radio technician has no knowledge to guide him. Starting with a given capital, he wants to know the answers to such simple questions as "How much rent can I afford to pay?" or "What part of my investment should I devote to test equipment?"

One of the leaders in bringing technical knowledge to the radioman, Howard W. Sams of the PhotoFact Service, decided to prepare a study on this important serviceman's problem. He found that nobody had any facts on which such a study could be based. And there seemed no way to get them. Various surveys had turned up bits of information on the business side of radio servicing, but these scattered and unrelated items were of little use to the radio technician starting up in business.

There was but one way to get the information—actually establish an experimental radio service shop, and learn the hard way—the only way a would-be serviceman can now learn anything about the business angles of his trade. Sams decided to start his own shop and learn by experience the opportunities and pitfalls of radio servicing.

The first step was into one of the pitfalls. A likely location was chosen. It was selected to combine low rent with a large volume of traffic past the store. An apparently ideal spot was found at

Work on the new Sams' test bench. Left portion is part of a second identical bench used to double length. The large stock of meters represents part of Sams' equipment-testing program.

the crossing of two main traffic arteries and a store was rented.

Only after starting work in the new shop was it noted that other considerations than rent and prospective trade are important in selecting a location. The new place was noisy. The trackless trolley past the shop daily took hundreds of prospective customers past the door, but it also sent out high-power broadcasts with each shower of sparks from the overhead conductors. Flashing neon signs on the two filling stations across the intersection also made plenty of noise, as did those of the supermarket next door. "Signal tracing" showed that three doctors and one dentist—with X-ray machines—were located in the block. Sams wrote his heading for Lesson One: "Check your proposed location for noise as well as its business possibilities."

Lesson Two was a design project. Problem: To find or design an efficient and suitable workbench. Sams had learned from many servicemen that what the majority wanted was something relatively inexpensive. For those who could afford a higher-priced bench, there were excellent commercial models.

The designers abandoned tradition and struck out along revolutionary lines. The bench they produced consists of two parts—a flat top and a pair of shelves behind it. These shelves are the novel feature.

The back of the average bench is used as a panel for instruments. But most instruments used today are the portable type. In servicing FM or television sets —where two or three instruments may be connected to the same receiver—the mobility and flexibility of the portable instrument are especially important. This bench is designed for use with portable instruments. They can be stacked on the lower shelf at bench level and directly behind it, and used either in place or pulled out to best position. Those used less can be kept on the upper shelves.

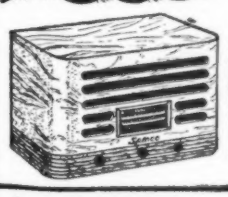
Another point in favor of the shelves is that customers dislike to see their sets scattered over the floor, where someone may step through the loudspeaker. The shelves provide space for such radios. Receivers whose repair is temporarily interrupted—while waiting for parts, for example—can also be lifted to a shelf. This frees bench space and thus adds to virtual bench area.

Another feature the technician will appreciate is the overhang at the front. See drawing, Fig. 1. Much repair work is done sitting down, and the overhang provides kneeroom. There is an accompanying disadvantage — the drawers must be spaced a few inches below the bench top for accessibility. Shelf space in the compartments beside the drawers permit storage of parts, radios, or larger tools, depending on the serviceman's need and the other fittings of the shop.

The bench may be expanded by placing its end to the wall and putting a second bench on the other side of the shelf rack. Two repairmen can then work without getting in each other's way, but both within reach of instruments.

(Continued on following page)

AMSCO SHOOTS THE WORKS!



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6-tube super-het, 2-band receiver . . . slug tuning. We furnish blond, Swedish modern cabinet, slug tuner and dial plate. Also schematic with list of other parts required $2.95

Kit with all necessary parts to complete above $6.95
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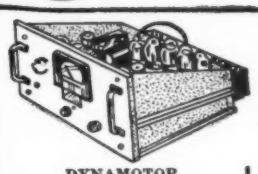

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110V. 60 Cy. Drawer type. Has milliammeter on front panel. Complete with tubes 6V6, 6J7, 45, 80, VR105 $9.95

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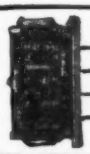

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½ and 1 Watt . . . Asst. Ohmic values . . .
100 for $1.69 500 for $6.95

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25 Knobs, all popular.... sizes $1.00

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519	Items	$33.35

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AND GET A MAGNESYN REMOTE INDICATOR FREE!
1 T-24 Mike with Cord and Switch $0.79

BUILD YOUR OWN AMPLIFIERS

20 Watt Amplifier similar to amplifier specified on page 42 of January Radio News. Uses 1-5U4G . . . 1-6SJ7 . . . 1-6SN7 . . . 2-6V6 push pull. Universal output transformer 8-12-16 and 500 ohms. Mike and phonograph input. Chassis 13" x 10". Complete with all parts and schematic diagram. $14.95
Less tubes .....
Complete with tubes $18.75

3 TUBE PHONO AMPLIFIER
AC/DC. Uses 1-35Z5 . . . 1-12SQ7 . . . 1-50L6. Set complete with all parts and schematic diagram. $3.95
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Kit includes assortment of:
100 Resistors, ½ and 1-watt.
50 Condensers, paper, mica electrolytic & can.
10 Switches, Toggle, Gang & Rotary.
100 ft. Spaghetti, various sizes.
12 Knobs, round and bar.
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Wire Wound Resistors—10 & 25 Watt.
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2 Panel Lights (1 neon).
1 Screw Driver.
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2 Panel Fuse Holders.
4 Binding Post Strips, and many other valuable items.
Your Cost $9.95 Complete

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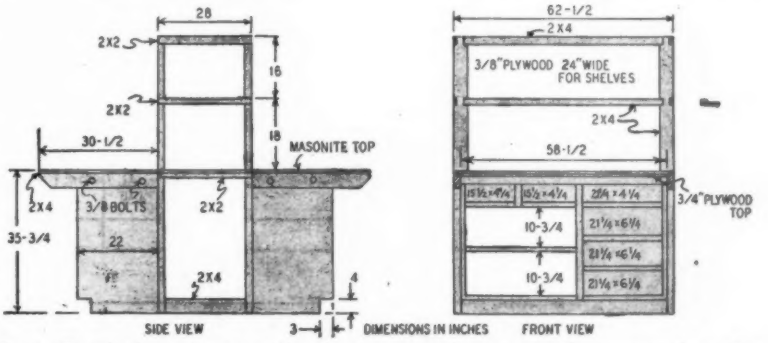
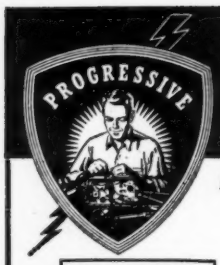


Fig. 1—The "kitchen cabinet" workbench, front and side views. Smaller areas on front view are drawers. Larger ones may be open shelves or be fitted with doors and back as closets.



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COMPLETE KIT ONLY...

ABSOLUTELY NO KNOWLEDGE OF RADIO NECESSARY
YOU NEED NO ADDITIONAL PARTS!

THE PROGRESSIVE RADIO KIT is the ONLY COMPLETE KIT

Operates on 110-120 volts AC/DC. Contains everything you need. Instruction Book, Metal Chassis, Tubes, Condensers, Resistors and all other necessary radio parts. The 36-page Instruction Book written by expert radio instructors and engineers teaches you to build radios in a professional manner. The first circuit built is a simple one-tube detector receiver. Each succeeding circuit incorporates new arrangements of detectors, RF and AF amplifiers. This kit is excellent for learning the principles of receiver, transmitter and amplifier design. It is used in many radio schools and colleges. All of the commonly-used detectors are used, including diode, grid leak, plate and infinite-impedance. The transmitters are designed with Hartley and Armstrong oscillators, using screen-grid and control-grid modulation. Both vacuum tube and selenium rectification are employed in these circuits. The circuits are designed to provide excellent performances. Altogether, fifteen circuits are constructed, including 11 receivers, 1 audio amplifier, and 3 transmitters. The sets start with simple circuits of 1 tube plus rectifier, gradually grow more complex, and finish with several examples of radio sets using three tubes plus rectifier.

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Designed for operation on 88-108 MC (new band), contains 2 IF transformers, 1 Limiter Transformer, 1 Discriminator Transformer, 1 RF coil, 1 Variable condenser, Schematic and wiring instructions. Excellent for schools, experimenters and Radio Hobbyists. Price only $4.95

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50 Paper Tubular Condensers. Values from .002 mfd to .1 mfd. 400 V. DC to 600 V. DC. Only $1.95

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100 Carbon Resistors, ½ Watt., RMA color-coded. Values from 120 ohms to 2.2 megohms $1.50

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PROGRESSIVE RADIO TOOL KIT
contains 75 Watt 110/120 Volt soldering Iron, long nose pliers & cutters, screwdriver, insulated alignment tool $3.25

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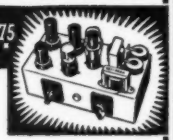

HIGH FIDELITY, HUMLESS, AMPLIFIER, SEVEN TUBE PEFORMANCE

This newest Progressive Kit will enable you to build a newly-designed, high fidelity, humless amplifier.
Beautiful aluminum custom-punched chassis, etched tone and volume control plates.
Designed by former Western Electric engineer.
Ideal amplifier for television kit or set, FM tuner, AM tuner, microphone, phonograph, wire and instantaneous recorders.
Electrify your musical instruments by connecting them to the Progressive Amplifier by means of a contact mike.
Amplifier can be readily modified to match the GE reluctance pick-up.
Separate mike and phono input. Regulated power supply maintains constant voltage supply. DC heater supply, whether amplifier is used on AC or DC, provides humless operation by eliminating cathode-heater leakage hum. Contains degenerative feedback for improved frequency response, balanced phase inversion and push-pull beam power output. Every stage thoroughly decoupled to improve low-frequency response and to prevent motor-boating. Tone and volume controls completely variable.
Seven-tube performance. Uses 2 selenium rectifiers, 2 beam power amplifiers, 1 high-mu pentode mike amplifier, 1 twin-triode phase inverter, and 1 voltage regulator tube.

Progressive AMPLIFIER KIT (less Tubes and Speaker)..... only $15.75

TUBES for Progressive Amplifier Kit 1-12SL7, 1-12SJ7, 1-VR75, 2-12A6's, Complete Set .....Only $3.00

BUILD A 5 TUBE AMPLIFIER - - only $9.75
Ideal for phonograph, FM tuner or microphone. Has 5 tubes including rectifier. Kit is complete with tubes, chassis, volume control, tone control, radio parts, hook-up wire, solder and instructions. We can provide a 4-inch PM. speaker with mounted output transformer to fit on chassis, priced at $1.95. Or use this kit with your own speaker. It has 5 watts output, more than enough to drive a 12-inch speaker.....Only $9.75

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SERVICESHOP TESTS SERVICESHOPS

(Continued from page 67)

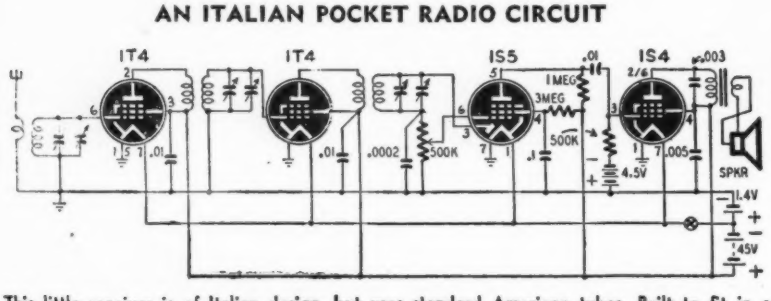
Lesson Three is on test instruments themselves. What instruments does the technician use most, and which can the small shop most easily do without? Are the test instruments offered to the radio repairman exactly adapted to his needs? To get the answer to these questions Sams enlisted the test instrument manufacturers. Cooperating to the fullest, they have supplied specimens of practically all pieces of test equipment currently on the market. All these will be used in checking radios on the bench. Not only will general conclusions be drawn, but weak and strong points of individual pieces of equipment will be noted and the manufacturer advised. Thus both manufacturer and his eventual customer, the radio technician, will benefit.

The new clinic expects to reverse the history of the small neighborhood radio shop. Many a serviceman has started in a small way and built up a reputation for skillful and reliable servicing, then moved on to the steadier dealer servicing, with its better income and reduction in the number of individual problems. Sams — reputation already assured — plans to start with the simpler dealer or manufacturer servicing. When some experience in general servicing has been obtained, the doors will be opened to radio owners of the neighborhood and the shop will proceed to the more advanced subject of individual customer servicing.

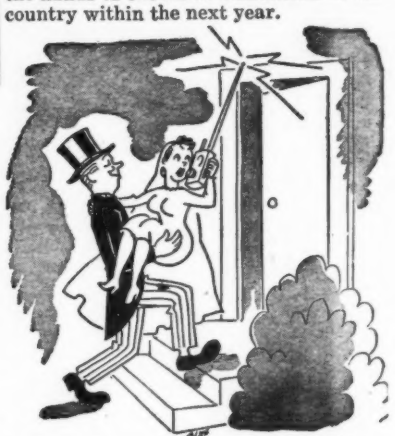
The lessons to be learned in this pioneer effort should be very valuable to the American radio technician. Indeed, there are so many things to be learned and this is so obviously the common-sense way to learn them, that the onlooker can only echo Sams himself and ask, "Why hasn't someone done it before?"

Baffling indeed are the problems which face the man trying to start his own radio service business. Sams intends to find some of the answers, and expects to have some of his solutions in the hands of the radio technicians of the country within the next year.

AN ITALIAN POCKET RADIO CIRCUIT



This little receiver is of Italian design, but uses standard American tubes. Built to fit in a pocket, it uses a t.r.f. circuit. American constructors will find the volume control connection and the use of a C-battery to supply bias to the output tube novel and interesting design features. The little set uses a 2-inch magnetic loudspeaker.

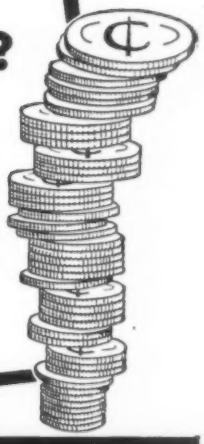


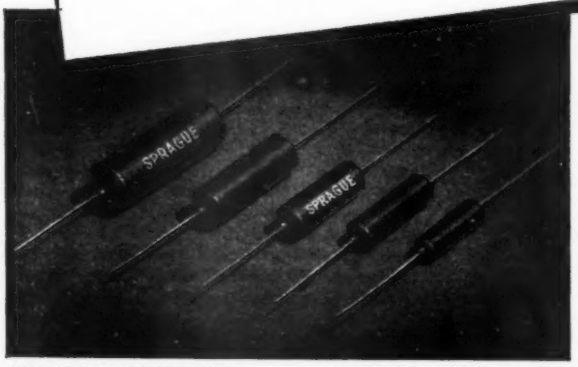
What shall I do next, Mother?

Suggested by Alice Laqueur, New York City

Why play "PENNY-ANTE"... when your business is at stake?

A good reputation, like good-will, is built by many deeds, but may be destroyed by a single dissatisfied customer. Your reputation is too valuable to risk for the few pennies "saved" by buying inferior or unknown "bargains." That's why we keep repeating *"Your Reputation and your customers deserve the best!"* And the best means Sprague.





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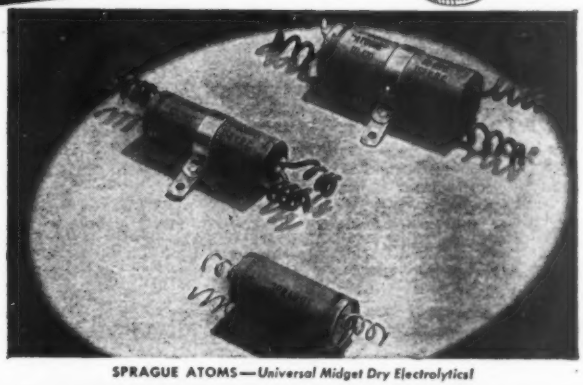

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OUTPUT TRANSFORMERS, match 50L6, 39c, push pull .. 55c, 6V6 ... 59c
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30—150V ..... "		.28
50—150V ..... "		.35
40/40/20—150V & 25V "		.44
50/30—150V ..... "		.44
8—450V ..... "		.27
10—450V ..... "		.32
16—450V ..... "		.36
16/16—450V ..... "		.59
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30—450V ..... "		.47
40—450V ..... "		.54

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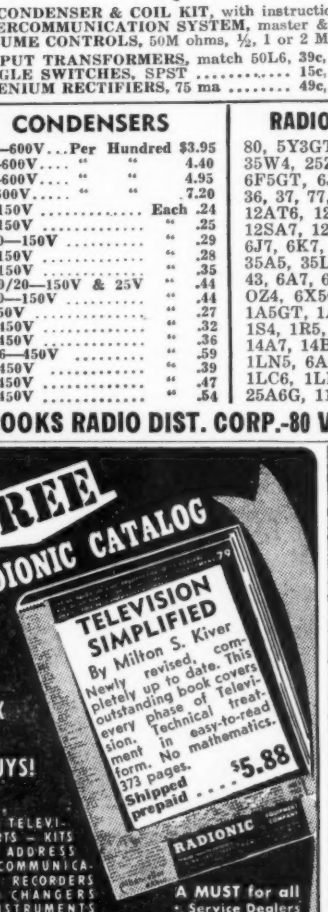
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TRANSATLANTIC NEWS

(Continued from page 38)

book, I think I'll play for safety. In the final revision of the proofs, besides changing every "is" into "may be" and every "know" into "believe," I'll insert "probably" into most of the statements.

Recent investigations in Britain have shown that *v.h.f. transmissions can, and regularly do, travel in no less than three other ways than by the direct wave!* One of these, the atmospheric duct, has been known for some time; but it was regarded rather as a freak condition. It has nothing to do with ionization. What happens is that, under certain conditions, a kind of wave guide is formed between a layer of air (which may be at a height of only a few meters) and the surface of the earth. The new discovery is that this is no freak; it is a common state of affairs in fine settled weather, such as we had over here last summer. This accounts for the regular reception in Europe at ranges of 130-150 miles of frequencies up to 58 mc.

But it doesn't account for transmissions of similar frequencies which span distances up to 1,400 miles as they did for many months in 1947 when European v.h.f. transmissions interfered badly with one 43-45 mc television service. That has been shown convincingly to be caused by sporadic E-layer ionization, which is found to be pretty frequent in summer time in these latitudes. Sporadic E is a superionization of the lower reflecting layer, which occurs more often and more widely than was formerly suspected and is influenced by sunspot activity. Appleton has shown that it can be caused by meteoric dust. Strong sunlight can also bring it about.

And now for a quiz question for which no prize is offered. Two places, A and B, are 1,000 miles apart. One set of radio waves from A reaches B by reflection from the E-layer at a height of 65 miles; a second gets there by reflection from the F-layer at a height of 200 miles. Which set meets the reflecting layer at the larger angle?

Those that travel *via* the E-layer? Right! The bigger the angle the smaller is the chance that the waves have of going smack through the layer and the greater the chance that they will be reflected, supposing that each layer is ionized to an equal degree. It follows that v.h.f. waves which would escape into space and never come back to earth under ordinary conditions may be returned to earth by a superionized E-layer. The observed critical frequencies of sporadic E are such that the maximum range obtained in this way by v.h.f. is about 1,400 miles.

Well, there you are. Those who said that there would be no mutual interference between v.h.f. stations working on the same frequency, so long as they were 40-50 miles apart, were somewhat off the mark. Atmospheric ducts can cause such interference up to about 150 miles, sporadic E up to 1,400, and F-layer superionization up to 5,000 miles or more.

And those are the waves of quasi-optical range!

WWV SCHEDULE CHANGES

Latest WWV schedules and services are contained in the Bureau of Standards letter circular LC 886, available without charge. WWV now transmits on the following carrier frequencies with power and modulation as stated:

carrier (mc)	*power (kw)*	*modulation (cps)*
2.5	0.7	440
5	8.0	440
10	9.0	440 and 4000
15	9.0	440 and 4000
20	8.5*	440 and 4000
25	0.1	440 and 4000
30	0.1	440
35	0.1	none

*0.1 kw for first 4 work days after 1st Sunday of each month.

Time signals are transmitted continuously on all above frequencies. Each second, except the 59th of any minute, is marked by a 5-cycle pulse of a 1000-cycle signal. It is heard as a faint tick each second, correct to within a microsecond. All of the r.f. and a.f. frequencies are correct to within one part in 50,000,000.

Tone modulation is applied for the first 4 minutes of each 5-minute period. Then c.w. code signals announce the next minute, using 24-hour notation. Midnight is 0000 and noon is 1200. For example, modulation starts at exactly 1 p.m. and stops at precisely 4 minutes past. Then code announces 1305 which is the next minute. At exactly 5 minutes past the modulation is resumed for exactly 4 minutes more. Then, at 9 minutes past, the announcement 1310 is made, etc.

The tone modulation is useful to servicemen for standardizing oscillators. The 440-cycle note can be used to standardize musical instruments since it represents the standard pitch A above middle C.

In addition to time signals and standard frequencies, ionosphere storm warnings are also transmitted. If such a disturbance is in effect or is expected within 12 hours in the North Atlantic area, a series of W's are sent following the time announcement at 19 and at 49 minutes past the hour. If normal conditions prevail a series of N's are sent instead. This service is useful for communication stations which may change to lower and more reliable frequencies to avoid fading and signal blackouts which usually accompany the storms.

ALARM CLOCK USES LIGHT

An electric alarm clock that will even awaken deaf persons is now on the market. In use, the bed lamp is plugged into the clock, and at the time set for the alarm, the lamp starts flashing on and off. A penetrating buzzer warning sounds seven minutes after the flashing starts. If the deaf person is not awakened, installation of a small photoflood bulb in the bed lamp is guaranteed to produce results in the most stubborn cases.

This famous-make FM antenna has been advertised and sold for many times the low price MID-AMERICA asks! Covers both FM bands. Delivers FM reception at its best. Complete with 60 ft. of 300-ohm twin lead-in. Line is standard approved flat-type, solid dielectric with weather-resisting insulation. Mounts anywhere easily . . . vertically or horizontally to match polarization of transmitting station. Illustrated instructions and all necessary hardware. A screwdriver is only tool needed for assembly. Dynatenna is seamless, heat-treated, all aluminum . . . will withstand severest weather.

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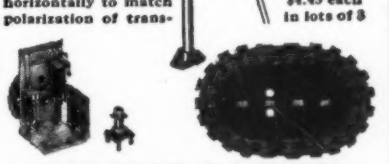

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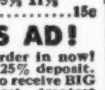

PL-259—Low-loss connector for RG-8/U and RG-11/U, or use adapter for other coaxial cables. Silver-plated, machined brass. Inserts are low-loss mica. Exceptional quality at a low price. MA-2828. **29c** ea.

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LABORATORY TYPE OSCILLATORS

(Continued from page 27)

Resistance-capitance oscillators

The resistance-capacitance tuned oscillator in Fig. 5 is used for the generation of audio frequencies. Frequency is controlled by an R-C network that provides regenerative coupling to a feedback amplifier. Main design points in this circuit are to use as few bypass condensers as possible and to make the ones used of high capacitance to minimize phase shift at very low frequencies. The amplifier must be designed for wide-band response to prevent phase shift at the higher frequencies and must also use a large amount of negative feedback. A 3-watt, 117-volt lamp is usually used in the cathode of the oscillator to provide the negative feedback. The lamp also automatically controls the amplitude.

Audio frequencies may be produced by a beat-frequency oscillator (Fig. 6),

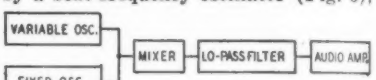

Fig. 6—A typical beat-frequency oscillator.

which is a combination of two r.f. oscillators, one fixed at about 100 kc and the other variable. The two outputs are fed into a mixer, then amplified. The difference between the 2 frequencies represents the audio output. A very wide range of frequencies extending well into the r.f. region can be covered with this type of circuit.

The b.f.o. has several drawbacks. The chief one is the tendency of the oscillators to "lock in" with each other at low frequencies. Unless filters are used together with careful design, cross-modulation of the higher harmonics occurs. For this reason the R-C feedback circuit is rapidly displacing the b.f.o.

Electron-coupled oscillator

Buffer stages are needed between most oscillators and their loads. A load connected to an oscillator changes the current in the tank circuit which in turn affects the frequency and might even stop oscillation entirely. If the load varies the oscillator will be adversely effected. The buffer stage can be eliminated by using an electron-coupled oscillator (Fig. 7). This is the Hartley circuit

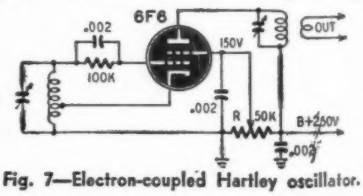

Fig. 7—Electron-coupled Hartley oscillator.

with a few changes. The screen grid is used as the anode and output is taken from the plate. The cathode is at an alternating potential above ground, but the screen is grounded.

The electron stream which reaches the plate is "modulated" at the frequency of

oscillation, and by inserting a tuned circuit in the plate lead as shown in the figure, it can transform the r.f. energy by either capacitive or inductive coupling to an external load. The plate circuit is at all times well shielded from the oscillating circuit, because the screen is grounded at radio frequency.

In all the above types of oscillators good wave form has been one of the most important features to be considered, but one oscillator with very bad wave form is much used—the multivibrator (Fig. 8). It is useful because it

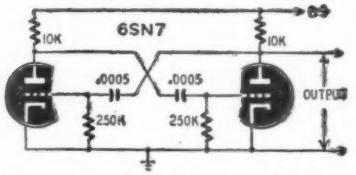

Fig. 8—A simple twin-triode multivibrator.

can "count down" a higher frequency to a lower one in predetermined steps. One important use is to divide the frequency of a crystal oscillator into a frequency suitable for running a synchronous clock. In this case, the crystal oscillator usually has a frequency of 100 or 1,000 kc. The output triggers the multivibrator, which generates subharmonics of the original frequency. By using two multivibrators, an output of 1 kc—or even down to 10 cycles—is entirely possible. The output will be just as accurate and stable as the crystal oscillator itself.

The wave form of the multivibrator is rich in harmonics that are usable up to the two- or three-hundredth. The output harmonics of a 10-kc multivibrator may be used to spot points on a receiver dial 10 kc apart up to at least 2 megacycles.

AMPLIFIER WITH FOUR INPUTS

Amplifier has four input channels and separate treble and bass controls. Push-pull 6L6's are used in the output stage.

The two microphone stages are unique in that d.c. from the cathode bias of the 6L6's is used on the filaments to reduce the hum level. A pair of 12SJ7's may be used in place of the 7C7 tubes if the 6L6 cathode bias resistor is changed to 280 ohms, 10 watts. The 7F7 is an electronic mixer and can be replaced with a 6SC7 or a 6SL7.

EUGENE K. GOODWIN,
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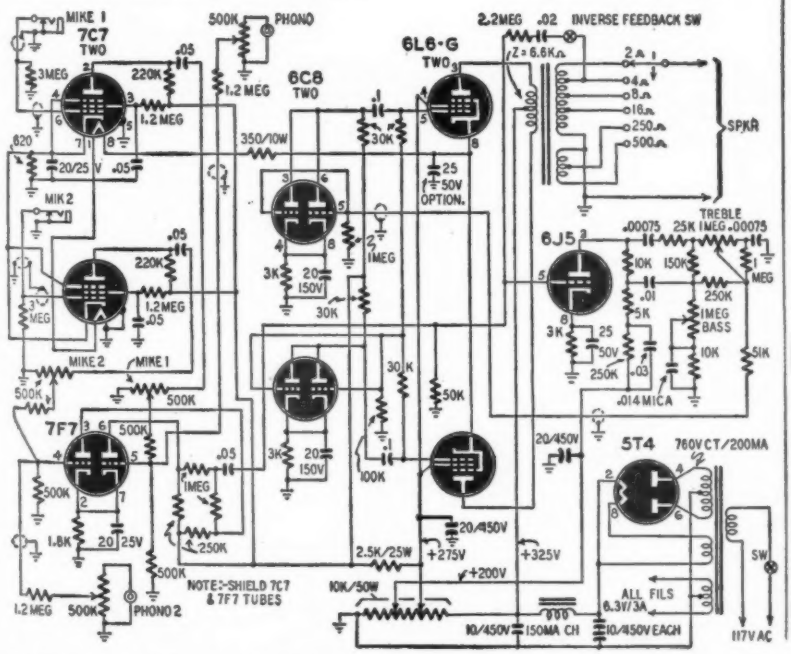

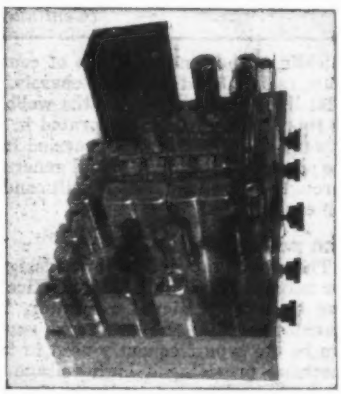

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A 12x16-foot rear projection plastic screen of our type was used.

F 1.9 TELEVISION PROJECTION LENS

Dimension — Length 7", Diameter 4¼".

F 1.9 EF. 5 in. (127.0 mm). This lens incorporates in barrel a corrective lens for use with a 5TP4 projection tube. It is easily removable for use with flat type tubes. Lens can be utilized to project picture sizes from several inches to 7 x 9 feet. Made by Bausch & Lomb Optical Co. .....Dealers' Price **$125.00**

Mounting ring available for above lens. Price $2.50

30 KV RF POWER SUPPLY

Dimensions—Length 14", Width 11", Height 11¼".

This unit has a low voltage supply separate from high voltage pack. Low voltage DC supply has control which enables you to vary voltage from approximately 12 KV to 40 KV. Unit has focus control built in for use with 5TP4 projection tube.

Dealers' Price, complete **$99.50**

STAND FOR PROJECTION TELEVISION SETS

Dimensions—23" High, 25" Wide, 18½" Depth. For use with RCA 630 chassis or Crosley table model sets. Unit mounted on ball bearing soft tired wheels. Depth is designed to accommodate RF Power Supply. Open grill allows free circulation of air. This stand a natural for mounting scopes and other lab. equipment for easy mobility. Specify whether for Television use or shop. Stand as shown in top photo.

Dealers' Price **$31.50**

REAR PROJECTION TELEVISION SCREENS

The screen surface consists of a conglomerate arrangement of microscopic plastic crystals that "Pin Point" the projected image providing unexcelled angular viewing with a minimum loss of projected light. It is estimated that there is a loss of approximately 10% of light viewing the image at 45 degrees off center.

Light transmission percentages are controlled to obtain the maximum efficiency of the television optical projection system.

The percentage of 80% of transmission has been determined as that providing maximum efficiency.

Stock sheets are available from 3x4 feet down. Specify inside dimensions of screen desired. If larger sizes are required, they can be made to order. Frames can be had on request, small sizes $5.00—large sizes $10.00.

Dealers' Price of screen, per sq. foot ... **$4.50**

Include 25% Deposit With Order, Balance C.O.D.

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WOBBULATED SIGNAL GENERATOR

(Continued from page 35)

shielding. The binding posts, of course, must be insulated from the chassis. No pilot light was installed in the wobbler, as this feature was incorporated in the power supply. All power is carried from the power supply to the signal generator through a rubber-covered multiconductor cable.

The power supply

The power supply (Fig. 9) was designed for universal use. The case is identical in size to the FM signal generator. The transformer for the universal supply can be the type frequently used in tube checkers, providing a high voltage for B-supply and various voltages for filaments. The author removed the filament windings from a large receiver power transformer (noting the turns/volt ratio) which had excess space in the winding window. A new filament winding was then wound, providing taps at the proper points for filaments up to and including 35 volts.

Precise voltage regulation of the B-supply is usually desirable for applications such as our FM generator. The original model did not include this feature, although voltage regulators were tried in some of the tests. The two VR tubes and the 2,500-ohm dropping resistor R25 shown in broken lines may be added within the same cabinet. When the regulator tubes are installed, S3 should be a d.p.s.t. switch.

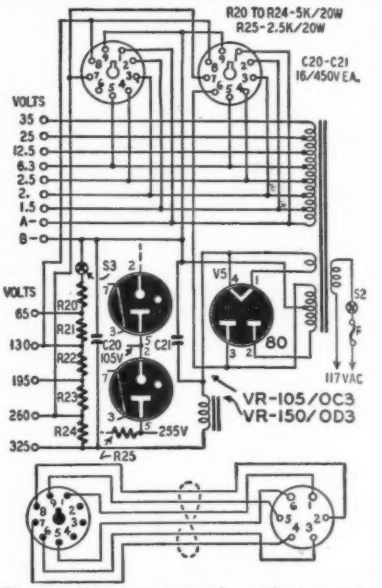


Fig. 9—The power supply and connecting cable. Note error in polarity of C20 and C21.

Adjustment and calibration

After the usual checks have been made on filament, plate, and screen voltages, the unit is ready for adjustment. First check both the input and output of the buffer tube V2 for proper form of all three wave shapes (Figs. 2, 3, and 4). The voltage gain of V2 will be slightly less than one, and the input and output wave forms should appear practically identical. While the wave shapes are being checked, the oscilloscope vertical input should be connected at the grid of V2 or V3 (binding post W). The square wave will show considerably greater amplitude than either of the other two, and great enough to allow production of a sizable trace without using the oscilloscope vertical amplifier. This method should be used to see the true shape of the square wave because the usual single-tube amplifier found in most oscilloscopes will distort such a wave shape. The triangular or pyramid wave is the one in which we are particularly interested.

Assuming everything has gone well so far, we now have linear triangular excitation for the frequency modulator. Start adjustment of this section of the unit with C7 at maximum (closed), R10 at maximum, and C18b partly open. The setting of C18b is unimportant for the moment. Connect the FM output to the oscilloscope vertical amplifier and adjust the oscilloscope sweep to 60 cps. Connect the output of a constant-frequency test oscillator (signal generator) to the r.f. terminal of the wobbler.

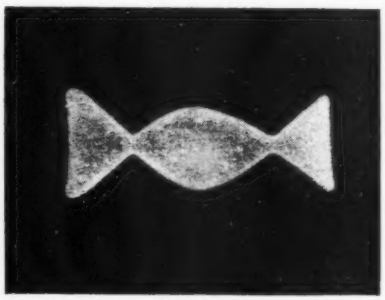


Fig. 10—How zero beat looks on 'scope screen.

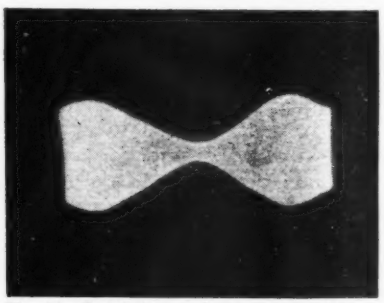


Fig. 11—Positioning node to center of trace.

Slowly tune the test oscillator 100-200 kc both sides of 450 kc. When the frequency of the constant signal falls within the deviation range of our frequency modulation, zero beat will be evident as indicated in Fig. 10. As the constant-frequency signal is changed, the zero-beat point will move back and forth across the 'scope trace. By adjusting (and reading) the constant-frequency oscillator dial so that the zero-beat nodes occur at the ends of the trace, and again so that they coincide in the middle (Fig. 11), the amount of frequency

sweep can be determined. The desired maximum sweep is 60 kc or a deviation of 30 kc each side of the center frequency. The exact amount of maximum deviation is not critical as long as it is adequate.

The value of R13-C7 determines the relationship between the out-of-phase voltage on the reactance tube grid and its plate current. Adjust C7 to give the desired 60-kc sweep. When R13-C7 becomes too small, oscillation over part of the sweep cycle may be blanked, as evidenced by a 'scope trace such as Fig. 12, obtained on the oscillator plate. Parasitic oscillations and complete instability can also result. Extending the sweep too far will also give a non-linear grid potential *vs.* frequency characteristic for the reactance modulator.

The final adjustment consists of setting the range of center frequency, after which the dial on C18a can be calibrated. The center frequency of the FM signal output at any particular setting of C18a is determined as follows. The FM output is connected to the oscilloscope vertical amplifier. The constant-frequency generator signal is injected at the r.f. terminal of the wobbler. The oscilloscope horizontal sweep is adjusted to 120

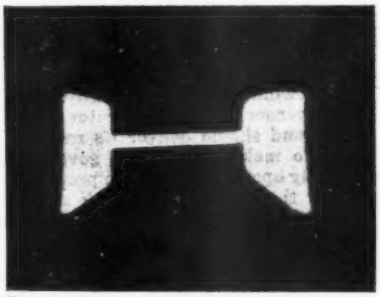


Fig. 12—Effect of making R13-C7 too small.

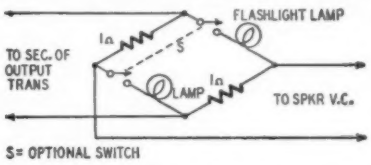
cycles per second. When the constant-frequency signal lies within the deviation of the FM signal, a double trace will appear on the 'scope, each trace being one-half of Fig. 10. When the zero beat points on the two superimposed traces coincide at the center, the constant signal is at the same frequency as the center of the FM signal. C18b is adjusted to give the desired center or carrier frequency range as determined by readings taken at the maximum and minimum settings of C18a. Varying C18b, of course, moves the range up or down the scale of frequencies as well as widening or contracting the range somewhat. It may be necessary, therefore, to alter the inductance of L slightly.

With the end points at the desired values, it is now necessary only to set the constant frequency at, say, 5-kc intervals over the selected range, bring the zero beats together on the superimposed 'scope traces, and mark the dial on C18a. The spaces between the 5-kc marks can then be divided into five divisions to give 1-kc calibration. The calibration will be essentially linear. Final calibration should be done with all shields and covers in place. Needless to say, the calibration will be no better than that of the fixed-frequency test oscillator used.

VOLUME EXPANDER

You may want to try a simple volume expander which will increase the dynamic range of phonograph records or radio programs. The only materials required are two flashlight bulbs (3½-volt, green-bead lamp for 3-cell flashlight seemed to be the most satisfactory in the model constructed), two 1-ohm resistors (a 4-inch length of No. 26 nichrome wire makes a very satisfactory 1-ohm resistor), and enough wire to connect these components together (as shown in the diagram).

At low levels, the lamp filaments pass little current and are quite cold. The resistance is low (in the order of several ohms) thereby almost balancing the volume expander bridge circuit to pro-



duce a small output to the loudspeaker voice coil leads. When the magnitude of the sound is increased, the lamp filaments heat up, and their resistance increases considerably, unbalancing the bridge circuit to produce a much greater output to the loudspeaker. In this way, changes in the dynamic level are accentuated.

To connect the volume expander to your radio or phonograph, disconnect the leads of the loudspeaker voice coil and insert the expander between the secondary of the output transformer and the voice-coil leads.

With the components used there may be too little or too much expansion to suit your taste. Substitute higher-voltage radio pilot lamps (such as 6-volt, brown-bead) to reduce the amount of expansion, or lower-voltage lamps to increase it. If you wish to use the expander for music only, a simple double-pole, single-throw toggle switch may be inserted in the circuit to break the legs of the bridge in which the lamps are inserted.

MILTON SNITZER,
Brooklyn, N. Y.

(This circuit is an adaptation of one developed by L. A. de Rosa and described on page 748 of the April, 1937, issue of *Short Wave & Television* and page 21 of the July, 1937, issue of RADIO-CRAFT, in which issues the system was described in some detail.)

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(The resistance of the speaker field must be high enough to prevent excess current from passing through it and the rectifier.—*Editor)*

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1B24	2.49	6AK5	.69	6X4	.98	36	1.10	801A	1.10	1631	1.49
1B38	4.50	6AL5	.99	6X5	.89	37	.69	802/RK25	1.49	1851	1.25
1G4	.98	6AQ5	.98	7AE7	.75	38	.89	803	8.95	2050	.90
1G5	.44	6AT6	.75	7B7	.69	39/44	.59	804	6.75	2051	.49
1G6	.88	6AU6	.89	7C4	1.50	41	.69	805	3.75	5514	4.75
1H4G	.98	6B4	1.29	7C5	.89	45	.64	807	1.25	7193	.39
1L4	.89	6B6G	.89	7F7	1.25	47	.90	808	2.95	8001	4.95
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2C22	.69	6F6	.79	12H6	.44	826	1.75	9003	.49
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2D21	.75	6H6	.49	12SH7	.89	84	.75	838	1.15	HF100	3.95
2E22	1.50	6J4	1.50	12SJ7	.79	85	.89	837	2.50	HY75	1.25
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6AB7	1.25	6SH7	.39	25Z6	.98	446A	1.25	991	.50	5BP1	1.49
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WIND GENERATORS

(Continued from page 33)

replaced. Brushes should also be replaced if they have worn down to where they do not hold their proper position in the brush holders. The mica between the commutator segments should be below the level of the copper bars. If it is not, it should be undercut, as the raised mica will prevent the brushes from making proper contact with the commutator. An ordinary hacksaw blade of the right thickness may be used.

Incidentally, an open bypass condenser or arcing at the brushes—caused by several reasons including those mentioned above—will cause static on the radio.

Check the field for continuity and voltage. If the field current has to be turned way up and the third brush all the way into the direction of rotation to make the generator produce a nominal amount of current, or if the strongest wind doesn't suffice to bring the output up to normal, the armature is either open or shorted. In either case it should be sent to the manufacturer or a motor shop for test and repair.

Generator speed has to be up to normal before maximum output can be expected. It can be checked without using a tachometer, by observing the governor. If the wind is strong enough to make the governor act, the generator is up to speed and should deliver its rated output. To make certain the governor is actually operating, slow the prop by applying the brake used to lock the prop when the generator is not being used, and watch to see if the governor relaxes.

Some of the governors turn the prop out of the wind. Others change its pitch, and still others throw out vanes which act as air brakes. No matter what the principle, the action is the same. They keep the prop's speed from exceeding its rated level. For example, *Wincharger* Models 617 and 1217 are set for 1,100 r.p.m. Governors can be relied on to do their job when in good condition and their action unhampered.

Insufficient Power problems

Lack of power over a period of time can be traced to one or more of the following: improper adjustment of control equipment, lack of sufficient storage-battery capacity, an undersized plant, or a plant poorly located with respect to the wind. An unrealized load may cause a complaint of low power. An example is a refrigerator lamp that doesn't go out when the door is closed. The lamp might draw a mere 25 watts, but, running 24 hours daily, it would draw a sizable amount of power. Other examples are a partially shorted motor and an incorrectly rated electric iron, any or all of which may lead the plant owner to believe he is consuming less power than he actually is.

Going back to the adjustment of controls, the smaller types of generators use the simple third brush and reverse current relay adjustments and controls. The third brush is connected to the field

and supplies it with a portion of the current generated. Moving the brush against the direction of rotation increases the field strength and output.

The reverse current relay (left relay in Fig. 1) is a simple cutout relay with a dual coil arrangement. One coil of fine wire is shunted across the generator output, and another of heavy wire is in series with the load and the contacts. Both are on the same core. When the generator starts to deliver current, the shunt coil is energized and closes the relay, connecting the generator to the load. When the wind stops, the battery voltage tends to drive the generator as a motor. The current, reversing through the heavy coil, opens the relay and breaks the circuit.

A typical adjustment for a *Wincharger* 6-volt relay would be: closing voltage, or cut-in: 6.9 to 7.3 volts, reverse or opening current: 1.5 amperes.

These measurements can be made with voltmeter and a 20-0-20 ammeter. To simulate a no-wind condition, the brake can be applied slowly and the generator slowed down until the reverse current opens the relay.

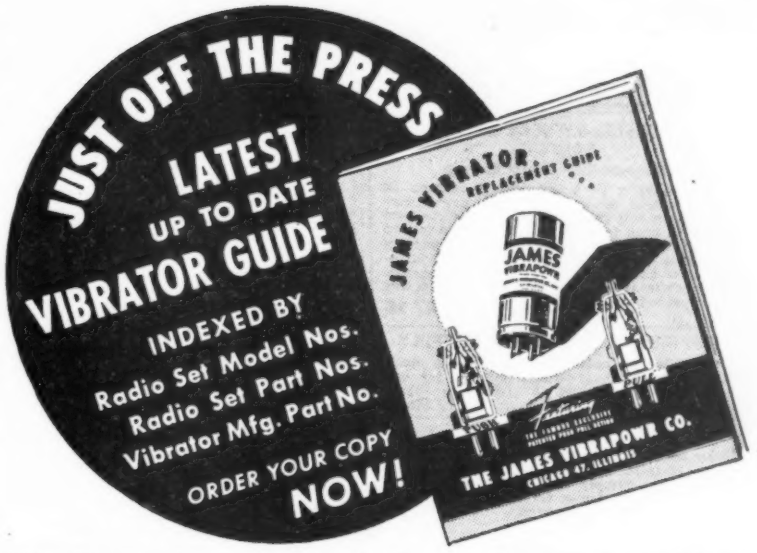
The larger plants have slightly more complicated controls. They dispense with the third brush and control the voltage with compound-wound field or a rheostat in series with the field (or both). To cope with fully charged batteries some of the control panels have a relay with contacts in series with the field and shorting a trickle-charge control rheostat. This appears on the right side of Fig. 1. When the battery voltage comes up the relay opens, putting the rheostat in series with the field and so lowering the generator output to a predetermined level.

Incidentally, operation of these relays is affected by room temperature, which should be checked before corrections are made.

Lack of sufficient storage capacity usually leads to continually run-down cells. Run-down cells, operated continuously around 1.150 instead of up around 1.250, will sulphate—develop a hard film on the surface of the plates that prevents the plates from taking a charge. The cure (when it works) is a long, slow charge. Prevention technique is to watch the hydrometer reading and charge the cells once a month until they emit gas for a few hours. This will also equalize them and bring their specific gravity up until their charge is equal.

Lack of capacity leads to a high charge and high discharge rate which shortens the life of the battery. Further, a discharged battery will freeze at a much higher temperature than will a fully charged one.

A word of warning. *Take care when you climb the tower!* Make certain the guys are in place and secured. Make certain no one is going to fool with the controls and relays. The generator, run as a motor, can easily throw you off the tower. Disconnect the batteries before going up. *And stay off in a strong wind!* The brake which locks the prop may loosen, and let go. One whack from the revolving prop can cut you in two.



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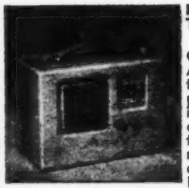

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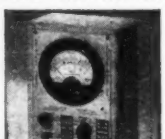

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RADIOMAN ON WHEELS

By RICHARD LAURENCE

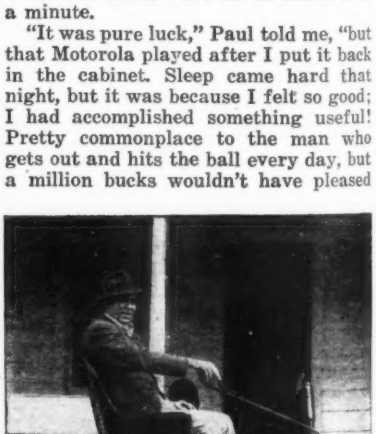
PAUL SKELTON, Vienna, Illinois, is a hard-working radioman. Like the great majority of the profession, he will give you a competent job on your set, and a square deal on the price. With parts and tubes now generally available, 2-day service is the rule. So what? There are thousands of guys like that over the country! Well, there is a difference. Paul is one of the small but growing number of "servicemen on wheels"—his only means of getting about being a wheelchair.

An automobile accident seven years ago crushed his spine and left his legs permanently paralyzed. His health was gradually restored, and his physical needs were well cared for, but he was oppressed by the growing futility of a life that did nothing but exist from one day to the next.

The radio was his greatest source of enjoyment. One day about 3 years ago he switched on for fifteen minutes of news analysis. The old Motorola warmed up smoothly, gave with the commercial, then squeaked, grunted, and died. That was the last straw. The only radioman in town had gone to the army a month ago, and there was no other set in the house. New radios, of course, were only a memory.

There was a screw driver and pliers handy, and Paul figured a pile of junk was just as good as a radio that didn't work. At least that's what he thought until a lunatic's dream of parts, wires, and connections confronted him. Grabbing the chassis firmly with his left hand, he probed every accessible spot with his right index finger. A large metal tube was intriguing, and he took a good grip on the heavy wire leading to it. The shock wore off in about half a minute.

"It was pure luck," Paul told me, "but that Motorola played after I put it back in the cabinet. Sleep came hard that night, but it was because I felt so good; I had accomplished something useful! Pretty commonplace to the man who gets out and hits the ball every day, but a million bucks wouldn't have pleased



Paul Skelton on his way to pick up a radio.

me more. The next day I thumbed through the magazine ads of the various correspondence schools, and picked out one by the heads-or-tails method."

With the aid of the State Rehabilitation Commission, Paul enrolled with National Radio Institute, Washington, D. C. As far as he knew, ohm was something that rhymed with home, so the first lessons pushed him around a lot. Furthermore, the habit of work and concentration had dulled. It was easy to let attention drift away from pages packed solid with technical material. But the course kept hammering away at the *chain* idea—the radio is fundamentally a chain of stages that boost the strength from antenna to loudspeaker. At last light began to seep through the murk. The first kit of experimental parts came. That helped by giving him something solid to work with. There is nothing theoretical about a hot soldering iron.

Finally the vacuum-tube multitester supplied by the school was assembled, and Paul borrowed a tube tester, since test equipment was not yet available. That was good—he was practically a serviceman now. The lady next door dropped her little set and brought it over. She wanted it in a hurry. Six hours later he was covered with cold sweat and cursing himself, the radio, and that multimeter. The lady came back and looked the set over critically. "Is that little wire over there supposed to be loose?" she asked.

He turned the set on and touched the loose end of the resistor to the various terminals around it. On the third try—music! He knew then they hadn't been kidding when they said to take a minute to look the set over thoroughly before starting trouble shooting procedures.

Trouble shooting broke down on the next set too, and it was guess and test until a shorted coupling condenser showed up. With the realization that there was plenty more to learn, Paul turned back to the course. Experience and study gradually made servicing more simple, but now the tube shortage came into the picture. Fifty percent of the jobs had to be turned back unfixed because there is no substitute for a burned-out tube. The school sent a list of wholesale radio supply houses in the area, but a score of letters produced not a single tube. He thumbed through the Sears, Roebuck catalog until he came across their list of available numbers. A good many 6-volt and several series rectifiers and loctals that could be substituted were there. Maybe it was technically dishonest to certify that those tubes were needed for equipment that was personally owned, but Sears, Roebuck kept him alive for the next year, and every tube they sent helped to put a radio back in working order.

Paul is over the hump now as far as technical knowledge is concerned. He now has a special wheelchair powered with a small gasoline motor, and which has gears, throttle, and brake completely hand-controlled. The tires are small 4-ply pneumatic, just like an automobile, and with this he is able to get out on the streets and go anywhere in town. Thus he is able to pick up and deliver some small sets. Due to the fact that his sitting-up time is limited by the spinal condition, he has to do part of his work while lying on his side in bed. Try it sometime! However, he hopes to be able to stay up the whole day eventually, and do all his work sitting at the bench.

There is new, adequate test equipment in the shop now, and the money he has earned has enabled him to build up a stock of tubes, parts, and diagrams. Of course, there are plenty of aggravations. He can't follow a radio into the home and see that it is hooked up properly, nor can he go after the chassis from a console model. Similarly, a lot of profit is missed on installing and servicing auto sets. To realize their full potential, a person handicapped in this way should have an active partner or employee so that he can devote his time to bench work. But radio servicing has put Paul back on the road to being a useful, self-sufficient citizen, and he believes it offers perhaps *the best opportunity of any available field.* He knows that nothing else could be as satisfying.

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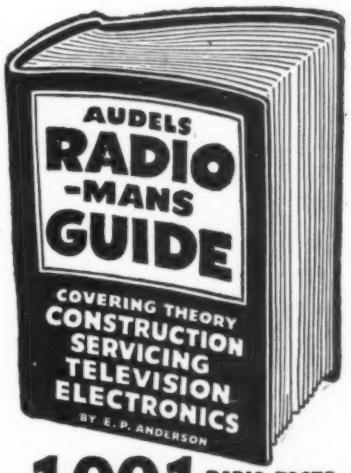

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12SQ7GT	.46
12SK7GT	.46
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.1	2500V	.60	.00005	3000V	.30
.1	7500V	1.85	.00005	5000V	.85
2x.1	7000V	4.75	.000067	2500V	.20
.12	15000V	6.95	.00007	2500V	.20
.25	1000V	.35	.00025	2500V	.25
.25	4000V	2.75	.00025	5000V	.85
.25	6000V	4.00	.0004	2500V	.22
10x.25	600V	1.00	.0005	2500V	.22
.5	600V	.28	.00072	5000V	.89
.5	1000V	.35	.0008	5000V	.89
.5	2000V	.40	.0001	2500V	.25
.75	2000V	.55	.0011	5000V	.89
.77	330VAC	.35	.002	1200V	.17
1.0	1000V	.45	.002	3000V	.66
2.0	1000V	.60	.0025	1200V	.15
4.0	600V	.60	.00275	2000V	.28
4.0	1000V	1.00	.003	2500V	.30
5.0	220VAC	.65	.003	3000V	.66
6.0	600V	.70	.004	2500V	.36
8.0	600V	.80	.005	600V	.13
8.0	1000V	1.75	.005	3000V	.66
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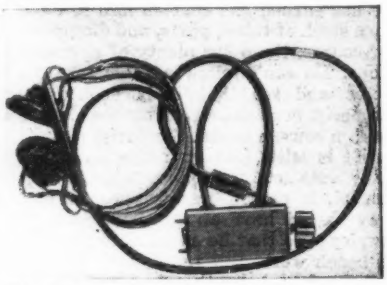
CHEAP AND EFFECTIVE NOISE LIMITER

NOISE limiters have been much in the news of late. Limiting is effective against the many types of sharp impulses that constitute most of the random racket heard in urban areas as well as a good portion of plain old static.

For maximum utility a limiter should be applicable to any existing receiver without alterations to the latter, inexpensive, simple, and as usable for c.w. as for phone reception.



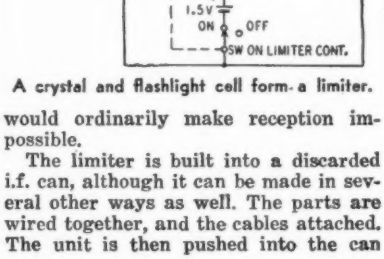
This limiter is a simple and compact device.

This simple noise limiter can be constructed for as little as two dollars at current prices. However, the average experimenter already has most of the parts in his junk-box, with the possible exception of the crystal diode. A 1N21 crystal was used because it was available, but any equivalent type may be readily substituted.

The principle of this type limiter is as follows: the diode is biased at 1½ volts by the dry cell and does not conduct until the audio voltage exceeds the bias voltage. When the signal exceeds the bias, the diode conducts, short-circuiting the headphones for the duration of the noise impulse. This amount of bias allows a 3-volt audio signal which is a comfortable signal in the headphones.

The switch enables the operator to cut the limiter out of the circuit at will. It is wired so that it opens with the threshold control at the minimum-resistance setting. The variable resistance permits the best setting to be made for any set of conditions.

The unit does a splendid job on c.w. operation. There is a small amount of audio selectivity, but the most impressive result is the a.v.c. action. Tuning across strong local c.w. signals is no longer an ear-splitting experience. Furthermore, it is possible to copy signals through static or man-made noise that would ordinarily make reception impossible.



A crystal and flashlight cell form a limiter.

The limiter is built into a discarded i.f. can, although it can be made in several other ways as well. The parts are wired together, and the cables attached. The unit is then pushed into the can with the control shaft brought out through a hole in the closed end. Line the can with stiff paper to avoid short circuits between can and wiring.

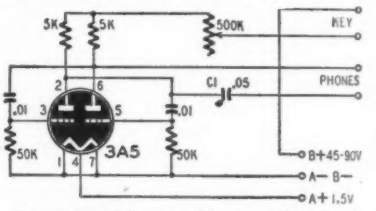
The size of condenser C is determined by experiment and will vary with some receivers depending upon the output circuit. In this model it is 0.1μf. There is no drain on the dry cell, and it should last a year or two.

The limiter works best with a strong signal. In use the receiver audio gain is advanced to the point where headphone volume fails to increase in proportion to the gain setting. This is the point where limiting begins.

The dx hunter will find this limiter a fine protection against tin ears caused by tuning in powerful stations while scanning the shortwave bands. It has no effect on the weak signals but holds the strong ones down.—*Otto Wooley WØSGG*

NOVEL CODE OSCILLATOR

A dual-triode, high-frequency miniature tube is used in this code oscillator. The circuit is simple and can be constructed compactly because it does not use a transformer. A 45- or 67½-volt battery is more than enough to operate this oscillator with good output into a pair of headphones. If a speaker is desired, increase the voltage to 90.



The pitch is varied by using different values for C1. The pitch is lowered by using a smaller capacitance.

RALPH DAY,
Moncton, N. B., Canada.

Radio Thirty-Five Years Ago

In Gernsback Publications

HUGO GERNSBACK
Founder

Modern Electrics	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Radio-Craft	1929
Short-Wave Craft	1930
Wireless Association of America	1908

Some of the larger libraries in the country still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

From the ELECTRICAL EXPERIMENTER, May 1914.

How to Calibrate E. I. Co. Slide Plate Condensers by *C. Laager*

Design and Construction Details of Radio Antennae, Part II, by *H. W. Secor*

The Wireless Society of London

Hertzian Wave Collisions

Boston Talks With Nagasaki by Wireless

Signals Via Wireless 6,000 Miles

Wireless Currents on Metallic Conductors

LIGHT WITH A MEMORY

(Continued from page 30)

straight out. Frequency can be changed by adjusting the trimmer condenser in parallel with the tank coil; the relay plate current is controlled in part by the antenna trimmer.

A base of ¼-inch plywood, hollowed to receive part of the relay, is affixed to the bottom of the panel by small brass screws. The receiver base is felt-lined, and both receiver and transmitter housings were painted with black crinkle-

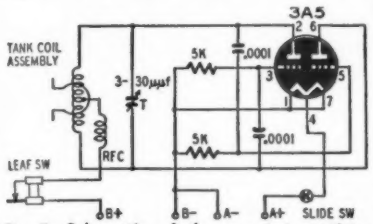


Fig. 5—Schematic of the secret transmitter.

finish lacquer. The hollow panel was built up of white pine.

Any small h.f. oscillator can be used. The one employed here was a type 3A5 twin triode in a push-pull circuit. Fig. 5 is the schematic, and a photograph of the transmitter with covers removed is shown at the right in Fig. 2. Two No. 412-E batteries were used to save space. A length of flexible 2-conductor wire is lead out of the transmitter to a leaf-type switch. The tank coil is 8 turns of No. 12 bare copper wire, ⅝-inch inside diameter, and a one-turn coil covered with insulation acts as an antenna and coupling coil. The r.f. choke is similar to the one in the receiver. Two C-cells in series with a slide switch furnish the filament supply. To conserve space the condensers and resistors are soldered directly onto the base of the tube.

The receiver unit is turned on just previous to the demonstration by rotating the dummy screwhead with a screw driver. The operator then explains the wonders of the light—emphasizing the waving of the hand over the lamp. After the spectator has pushed the push-button the desired number of times, the operator secretly pulses the transmitter with the concealed leaf switch, and the fun begins. The ultra-compact size of both units precludes the possibility of any radio device, especially in the minds of those steeped in radio theory. As a further convincing demonstration, the spectators may be allowed to hold the panel in their own hands.

CORRECTION

The grid coil L1, in the phono oscillator diagram on page 77 of the January, 1948, issue, is shown with a direct short circuit across its terminals. The diagram should show a 365-μμf condenser inserted in the lead which shorts L1. A standard-size condenser or a small mica compression type may be used.

Our thanks to Mr. Thomas A. Stoner of Wauwatosoa, Wisconsin, for this correction.

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1A7	59	49	7A7	58	48
1U5	36	30	7B6	44	35
1V	45	39	7F7	49	44
1L4	55	49	7N7	49	44
1T4	69	55	7Y4	44	35
1S5	69	55	7X7	44	35
2A7	49	39	7AF7	44	35
2A5	65	55	12A6	35	25
2A6	49	39	12A8GT	45	37
2X2	35	29	12AT6	50	45
3A4	69	59	12BA6	50	45
3S4	69	59	12BE6	50	45
5U4G	50	40	12J5GT	35	27
5W4GT	40	36	12J7GT	45	39
5Y3GT	40	33	12K7GT	45	39
5Y3G	42	37	12K8	65	59
5Y4G	40	37	12Q7GT	45	39
5X4G	40	37	12SA7GT	40	32
5Z4	59	49	12SF7	39	34
6A7	50	45	12SQ7GT	40	32
6A8GT	49	39	12SK7GT	45	35
6AC5	98	92	12SR7	39	34
6AC7	65	60	12SJ7GT	55	49
6AK5	74	69	14A7	65	55
6AG7/6AK7	89	79	14B6	59	49
6B7G	55	49	24A	49	39
6C4	29	25	47	49	39
6C5GT	40	35	57	45	39
6C6	45	32	58	45	39
6C8G	37	29	71A	39	29
6F6GT	45	39	75	50	39
6H6	45	39	76	45	39
6J6	55	50	77	35	27
6H6GT	45	39	80	40	38
6J5GT	45	39	83V	99	89
6J7GT	42	38	85	49	45
6K6GT	45	39	99V	35	25
6K7GT	49	39	99X	35	25
6K7G	50	41	25L6GT	49	39
6L6G	79	69	25Z5	49	45
6Q7GT	47	39	25Z6GT	45	39
6S7	59	48	35W4	43	40
6U7G	35	25	35Y4	43	40
6V6GT	45	39	35Z3	44	35
6X5GT	49	39	35Z5GT	43	39
6SA7GT	44	37	35L6GT	45	39
6SH7GT	40	32	35/51	49	39
6SJ7GT	44	37	50L6GT	50	45
6SK7GT	49	39	117Z6GT	89	76
6SL7GT	49	47	50B5	42	32
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ELECTRETS
(Continued from page 21)

Electrets in general

Electrets made in heated sand, the heat being brought up slowly and the charging voltage allowed to stay on until the sand cools to room temperature, are the most consistent in their characteristics. The quicker the wax is melted and the shorter the charging and cooling period, the quicker the electret reverses. Some electrets will never show a positive polarization. Both sides may indicate a minus field though one side will usually show much greater charge than the other. A quickly made electret is more prone to show this effect than one made slowly. Some electrets were made with raw high a.c. These were generally minus on both sides. Some of these minus-type electrets are over three years old and are just as active as those made in the conventional manner.

Electrets are extremely subject to moisture. Dipping in a moisture-repellent solution has been tried with poor results. A very good and practical method for keeping electrets is to wrap them in foil and place in can with a dehydrant.

Electrets show the greatest charge if tested immediately when removed from their short-circuiting foil wrap. Repeated discharge tests show a gradually diminishing spark. This, when considered with moisture effects, indicates a use where the unit can be enclosed almost to a short circuit and, if possible, space included for renewable dehydrant. A condenser mike or phono pickup could be made in this manner. Electrets have been made from the size of a 25-cent piece to 4 inches in diameter, and apparently the size can be increased. Thus, perhaps, a large diameter electret can be used as a condenser loudspeaker. The charge can be placed on wax from any angle that physical conditions will allow, therefore indented areas can be molded in so as to allow free vibration of the diaphragm. As an alternative, small electrets can be assembled in the same plane of polarization to any desired area, with air space included, giving the same field as a one-piece unit. The voltage to use for charging electrets of any size is that just under the breakdown point.

It should be understood that the electret represents a static charge and is not a source of power in the usual sense. We must do work in front of the surface to get an indication. The polarization is not a surface effect. The writer has shaved an electret from .18-inch thickness down to .120-inch and could still get a good spark discharge.

A group of finished electrets is shown in Fig. 6. No. 1 has foil partially removed and illustrates manner of wrapping. Nos. 1, 3, 4, and 6 are made with carnauba and Halowax; No. 2 with carnauba and resin; and No. 5 with carnauba, resin, and Halowax. No. 6 has top plate left in position as when charged. No. 4 is cracked badly due to quick cooling.

COMMUNICATIONS

NO LICENSING IN BRITAIN

Dear Editor:

I have to thank you for your letter dated November 20, with the advance clipping *Should Servicemen be Licensed?*

The problems which may make necessary the licensing or control of the radio service trade in the U.S.A. are apparent over here, but we do not admit that state or official control will be necessary, and it is certainly not desirable.

We are able to handle the matter in another way, since the trade is well organized at all levels in the Radio Manufacturers Association, the Radio and Television Retailers Association (with its affiliated organizations, the Scottish Radio Retailers Association and the Northern Ireland Radio Retailers Association) and the Guild of Radio Service Engineers. My organization is the accepted representative body for the employed radio service engineer throughout the British Isles, and we have comprehensive agreements with the abovementioned organizations as to wages and working conditions. Various standing joint committees deal with other aspects, such as juvenile technical training (apprentices), trade practices, etc.

It has been recently agreed to set up a Radio Service Trade Register, with representatives from all the organizations concerned forming the Register Council. Minimum technical requirements have been laid down, and all engineers are invited to apply for registration.

The trade has agreed to recognize as qualified radio service engineers only those whose names appear on the Register, and a Certificate of Registration will be issued. Suitable propaganda will be undertaken to bring the meaning of the Register home to the general public. There seems to be no doubt that this scheme will eventually give us the control necessary to eliminate the undesirable elements.

It should not be necessary to add that, although the Register is sponsored by the various trade organizations, it is open to all who can prove their competence, whether members of their appropriate associations or not.

J. H. CORBETT, *Secretary*
Guild of Radio Service Engineers,
Holland-on-Sea, Essex, England.

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one or two new commercial circuits a month gives the technical information necessary on current manufacturing practices without cluttering up the pages with circuits that the non-serviceman reader will ever use.

4. Your coverage of test equipment is good. But how about more frequency meters, oscilloscopes, and signal generators? And why not a discussion of new circuits used in commercial equipment?

In brief, you have a well-balanced magazine.

K. E. FORSBERG,
Sauk Center, Minn.

A CHANGER USER REPLIES

Dear Editor:

Jack King, in his article, *Selling A Radio*, in the December, 1947, issue, expressed amazement at the popularity of record changers. Surely the reason for this popularity is obvious.

I don't believe that anyone who plays a single record at a time ever hears more than the middle of the record. The beginning and end are obscured by his dashing to the phonograph, changing the record, and finally dashing back to the cozy armchair for another few minutes, and so on and on.

I have used a changer for the past 12 years or more and wouldn't think of using a manual record player, no sir!

Is a changer unreliable? Only if it is misused! And the maintenance costs? A drop of oil once in a while, that's all.

The only thing that amazes me are the weird arguments against changers by people who don't seem to have a clear idea what they are talking about.

R. G. YOUNG,
London, England

DON'T WASTE GOOD SPACE!

Dear Editor:

Please, *please* stop wasting space—valuable space—in RADIO-CRAFT telling servicemen how to run their business. And this stuff about licensing servicemen! They license doctors and lawyers—but they don't guarantee their continued excellence. Let the good servicemen go about their business unperturbed. The service field will never be crowded for the GOOD serviceman.

Don't print so many how-to-build articles that ordinary people can never hope to build—like the 17-tube FM receiver. I'll bet that not 25 of your readers built it. Why not concentrate on more simple educational articles?

H. W. SMITH, *Radio KNAF, Fredericksburg, Texas.*

(What say, servicemen and constructors?—*Editor*)

IMPROVED SIGNAL TRACER

Dear Editor:

In the February, 1947, issue you published details of the probe tracer, with which diagram I've been experimenting ever since. You would probably be interested in the final (or at least, the latest) result.

For its size and efficiency, the original is possibly the best tracer diagram

you have published, to say nothing of its low cost. All parts except the tube and batteries came from the junk-box.

The latest result, built into an overnight case, is used with a separate probe and ground clamp, the tube and all parts being in the case, which also holds the headphones and probe. Of several probes tried, the most satisfactory one was made with an old crystal detector with the *Intermittent Tip* described in the August, 1946, issue. This combination will pick up easily a signal anywhere in the radio (or from an antenna coil on the bench, for that matter) with a strong local station, and from the audio end of the radio will drive a small p.m. speaker.

I find a 20-megohm grid leak works much better than the 2-megohm in the original. I also changed the 500,000-ohm volume control to one of 250,000 ohms. Otherwise the hookup remains the same except for the necessary changes in using it with a separate probe.

Finally I hooked a milliammeter in the plate circuit with a double-throw switch, providing both visual and aural checks. All of which adds up to a mighty efficient and easily portable tracer. More power to RADIO-CRAFT!

R. C. SANDISON,
Denver, Colorado.

LIKES CRYSTAL SET

Dear Editor:

I built the *Modern Midget Crystal Set* described in the January issue. It is the best-performing crystal set I have ever made, and I have been experimenting with these sets for more than 25 years.

This receiver separates stations like a superhet and the volume it delivers for its size is amazing. I can operate a small speaker on a signal from a 5,000-watt station 5 miles away.

The sensitivity is so good that hooking the antenna to a metal bridge lamp gives reception almost as loud as with an outdoor antenna.

Mr. Grace's idea of using two secondaries appears to be the secret of the performance of this set. Funny we never thought of trying that!

JOSEPH AMOROSE,
Richmond, Va.

PORTABLE ANTENNA

Dear Editor:

The one drawback to my 2-tube regenerative portable receiver was that it needed a rather long antenna. After tacking a small plate of galvanized iron on the heel of each shoe and connecting them in place of the antenna I found that the set pulled in the locals satisfactorily when I walked on the damp ground.

BEN GREEN, JR.
Tuscaloosa, Alabama

(Here at last is the true portable, rotatable antenna. But what happens on a boardwalk or clean dry sand? On second thought, the equipment could be used as a soil analyzer, the strength of signals showing the conductivity characteristics of the ground immediately below.—*Editor)*

The June RADIO-CRAFT will be a special FM number, full of articles on FM theory, FM construction and FM servicing. The most popular FM receivers and tuners will be reviewed and there will be a new and up-to-date list of FM stations.

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1Q5GT	0.79	0.70	6SQ7GT	0.47	0.42
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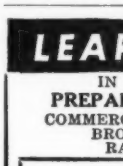

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BOOK REVIEWS

THE RADIO AMATEUR'S HANDBOOK (Twenty-fifth Edition—1948), by Headquarters Staff of the American Radio Relay League. Published by the American Radio Relay League. Flexible fiber covers, 6½ x 9½ inches, 608 pages plus an 8-page index and a 144-page manufacturers' catalog. Price $2.00 in U. S. A., its Possessions and Canada; $2.50 elsewhere.

It is indeed difficult to review "The Handbook" for we feel that it is too well known to need an introduction. We cannot imagine anyone with an interest in radio without at least one edition in his possession.

The latest edition of the handbook has 25 chapters—four more than last year. We cannot compare these editions by counting chapters. This year, the editors have found several opportunities to combine theoretical and construction material. For example: the material that was in the chapters on radio-frequency power generation and transmitter construction in previous editions has been combined in a chapter on high-frequency transmitters. When theoretical and practical material is correlated in this way, the reader is often able to grasp difficult ideas that he is unable to understand from orthodox texts.

In addition to the usual transmitter and receiver circuits, there are five new chapters devoted exclusively to v.h.f., u.h.f. and microwave techniques and equipment. The vacuum-tube data tables have been brought up to date to include the latest tubes.—*R.F.S.*

ELEMENTS OF RADIO SERVICING, by William Marcus and Alex Levy. Published by McGraw-Hill Book Co. Stiff cloth covers, 6½ x 9½ inches, 475 pages. Price $4.50.

Written to provide needed information on radio servicing especially for the beginner, the authors assume that the reader already has a knowledge of radio theory, but theory is reviewed wherever they feel it would clarify a procedure.

The book is clearly and comprehensively written and profusely illustrated with pictures and schematics of typical circuits and modern receivers. Complete summaries and study helps, together with questions dealing with actual service problems, are found at the end of almost every chapter.

Outstanding features are the stage-by-stage analyses of the different receiver circuits and components, discussion of the faults most likely to develop, and explanations of the testing procedures used to locate them.—*H. W.*

PREPARING FOR FEDERAL RADIO OPERATOR EXAMINATIONS, by Arnold Shostak. Published by Prentice-Hall, Inc. Stiff cloth covers, 5⅛ x 7⅝ inches, 404 pages. Price $3.75.

This book was written expressly for the student who is preparing to take the examinations for commercial radio operator's licenses.

The questions which appear in the book are taken from the FCC's pamphlet, "Study Guide and Reference Material for Commercial Radio Operator's Examinations." Selections of questions from this pamphlet make up each examination. Following each question is its answer, given in the most simple and direct form, yet designed to give the student the background on the theory or practice involved.—*H.W.*

HOWARD W. SAMS RADIO RECEIVER TUBE PLACEMENT GUIDE—Covering Most 1938 to 1947 Receivers, compiled and published by Howard W. Sams & Co., Inc. Stiff paper covers, 5¼ x 8¼ inches, pages not numbered. Price $1.25.

The problem of replacing tubes in unmarked sockets of radio receivers is simplified by this new book. It contains 1,880 diagrams showing the socket locations of almost 5,400 different sets produced under 107 trade names. The book is also useful in identifying a tube whose type number has been worn off before being removed from the set.—*R.F.S.*

PRACTICAL AMPLIFIER DIAGRAMS, by Jack Robin and Chester E. Lipman. Published by Os-tronic Publications. Spiral binding with flexible paper covers, 8½ x 11½ inches, 41 pages of diagrams and 59 pages of parts lists and instructions. Price $2.00.

Schematic diagrams, parts lists, and instructions for building 45 different types of audio amplifiers are included in this book. The diagrams include a hearing aid, recorder and playback amplifiers, public address systems, phono amplifiers, intercommunicators, and transmitter modulators. The intercommunicator diagrams are for battery, a.c.-d.c., and quick-heating a.c. models. The amplifiers range from a 1-tube, 1-watt job to a 75-watt multi-channel amplifier.

Most of the circuits described are designed to pass frequencies between 50 and 12,000 cycles. There are some high-fidelity circuits designed to pass frequencies up to 20,000 cycles.—*R.F.S.*

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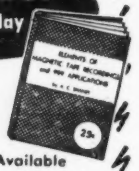

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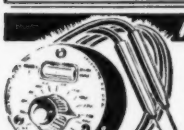

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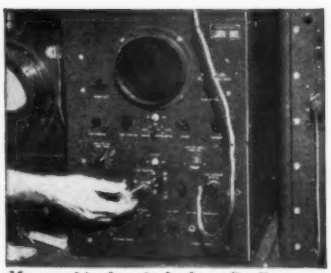
Somewhat More Silent Than a TOMB!

It's Impossible to Hear a Mallory Control Operate!

Even super-sensitive meters, built for the U. S. Navy to inspect delicate electronic communication equipment, do not show an audible sound level when Mallory carbon controls are tested.

Mallory carbon controls give you totally silent operation—the tapers are smooth and accurate to assure maximum adjustment in the proper ranges—the overall resistance values are uniform and the life of the control is the longest ever provided. This kind of quality keeps customers satisfied.



Meter used in the noise level test. Readings were taken on volume controls of all leading manufacturers. Mallory controls gave no audible sound, registered 22% below all others in inaudible sound vibrations.

Mallory has given you so many "firsts" in the field of radio-electronic replacement parts that you know Mallory products are the finest that can be produced! Sell them with confidence, install them with ease. The Mallory line of Volume Controls, Capacitors and Vibrators has been standardized; they are a profitable line to stock.

"Good Service for Good Business"

A business plan that will raise the earnings of radio-electronic servicemen. One important item in the plan is a unique system for following up your customers for repeat orders.

And there are ways of linking your name with the Mallory trade mark, to get the benefit of Mallory advertising. Better ask your distributor about it!

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1	D13-133X	500,000 ohms	B
1	D13-137	1.0 meg.	A
1	D13-137X	1.0 meg.	B
1	D13-139	2.0 meg.	A

Purpose: A-Tone or Audio Circuit control; B-Tapped for tone compensation.

SWITCHES

3	#41	S.P.S.T.
1	#42	D.P.S.T.

SHAFTS

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3 Type "E" with universal knurl for special type push on knobs.

1 Type "H" with universal groove for many Delco, RCA, Sears-Roebuck and Westinghouse models.

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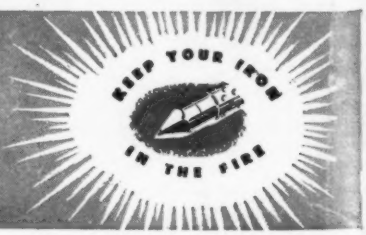
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